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Structure and Agency in International Research Collaboration

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Navigating Inequality in Science

Structure and Agency in International Research Collaboration

ANNIKA RALFS | DEPARTMENT OF BUSINESS ADMINISTRATION



Navigating Inequality in Science

Structure and Agency in International Research Collaboration

International research collaboration is often celebrated as a pathway to scientific progress; however, it is shaped by deep structural inequalities between high-, middle-, and low-income countries. These imbalances can hinder global efforts to address urgent societal challenges, which disproportionately affect middle- and low-income regions. This thesis explores how both structural constraints and individual and collective agency shape patterns of collaboration across these global divides. Drawing on a combination of quantitative and qualitative methods, it connects systemic structures with the day-to-day dynamics of research teams. The findings reveal that inequalities influence motivations to collaborate, create barriers, and are reflected in team dynamics, including the division of labor, the setting of research agendas, and the alignment of perspectives. Depending on their design, science policy tools—such as science diplomacy, researcher mobility programs, and capacity-building initiatives—can either expand participation or reinforce existing disparities. By examining the interplay between persistent structures and agency, this work provides a nuanced understanding of international scientific collaboration. Ultimately, it highlights pathways toward more equitable, inclusive, and impactful global research partnerships.

Navigating Inequality in Science

Navigating Inequality in Science

Structure and Agency in International Research
Collaboration

Annika Ralfs



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Abstract:

International research collaboration stands at a pivotal juncture, shaped by enduring structural inequalities between high-, middle-, and low-income countries and challenged by a trend of withdrawal from international collaboration. These asymmetries can create a misalignment between global scientific progress and the capacity to address pressing societal crises, which often disproportionately affect low- and middle-income countries. Adopting a critical realist perspective, this thesis examines the interplay of structure and agency in shaping patterns of scientific collaboration across global divides. Combining quantitative and qualitative methods, it connects macro-level systemic structures with the meso- and micro-level dynamics of research teams. Findings reveal that inequalities manifest across multiple dimensions of collaboration—including motivations and barriers to partnering, team dynamics, the division of labor, and agenda-setting in projects spanning high- and low-income regions. At the same time, science policy instruments—shaping science diplomacy, researcher mobility, and capacity-building initiatives—carry a dual potential: they can broaden participation while also risking the reinforcement of existing inequalities. The study highlights the dynamic interplay between persistent structures and the role of individual and collective agency in responding to them. Assessing inequality in the current research system provides a foundation for developing pathways toward a future of international collaboration characterized by more equitable and inclusive partnerships.

Key words: International research collaboration; Scientific inequality; Global South–North relations; Critical realism; Science policy; Equitable partnerships

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Navigating Inequality in Science

Structure and Agency in International Research
Collaboration

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List of Papers

Paper I

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Paper IV

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1. Introduction

It has long been argued that international research collaboration plays a central role in advancing scientific knowledge by enabling researchers to combine expertise, resources, and perspectives across disciplinary and national boundaries. When addressing complex global challenges such as pandemics or the climate crisis, collaboration across institutions and countries is often regarded as particularly promising. However, persistent inequalities among high-, middle-, and low-income countries (Kyobutungi et al., 2021), together with the resurgence of science nationalism opposing scientific globalism (Shih, 2024), may impede progress toward these goals. These dynamics raise critical questions about the conditions under which international research collaboration occurs, who participates, and whose interests are served.

The global scientific system is characterized by significant disparities in resources, infrastructure, and influence (Koch et al., 2025; Muriithi et al., 2018; Vasconcellos et al., 2018; Walsh et al., 2016). High-income countries, primarily located in the Global North, are often positioned at the center of research networks, with greater access to funding, agenda-setting power, and publication platforms (Aksnes & Sivertsen, 2023; Bradley, 2008; Chavarro et al., 2017). In contrast, researchers from low- and middle-income countries (LMICs), particularly in the Global South, are situated in more peripheral areas and may encounter collaboration structures that are externally driven, donor-dependent, or shaped by limited institutional capacity (Schneider & Maleka, 2018; Sridhar, 2012; Tetteh et al., 2020). These patterns reflect broad and enduring structures of inequality within global science. At the same time, shifts in political priorities — including in many high-income countries — have led to a retrenchment of funding for international collaboration, alongside growing skepticism toward science that does not serve immediate national interests (Lynch & Goldenberg-Hart, 2021; Gumaelius et al., 2025). Here, exploring how researchers navigate and experience international collaboration within unequal structures sheds light on the shifting dynamics of global science and its possible futures.

This thesis adopts a critical realist perspective (Bhaskar, 1975; Sayer, 2000) to examine the interplay between the structural conditions that shape global scientific inequalities and the agency of individual researchers who navigate these conditions. In this context, *structure* refers to enduring social relations, rules, and material conditions that shape possibilities for action, whereas *agency* denotes the capacity of individuals or groups to act, reflect, and potentially transform the structures they inhabit. Recognizing the interdependence of structure and agency (Sibeon, 1999) offers a valuable framework for examining how inequalities in international science are produced and sustained. However, existing approaches often address them in isolation, paying limited attention to how researchers actively navigate unequal structures (Walker & Martinez-Vargas, 2022).

The separation of structure and agency is also evident in the scholarly literature. Explanations of persistent inequality in science primarily draw on macro-structural theories, whereas studies of international research collaboration often employ meso- or micro-level frameworks that focus on researchers' relational dynamics.

Theoretical work on inequality in science has primarily focused on macro-structural explanations. Postcolonial perspectives trace enduring colonial legacies and epistemic hierarchies (Spivak, 1988; Mohanty, 2003). World-systems theory situates global science within a core-periphery hierarchy favoring high-income countries (Schott, 1998; Wallerstein, 1974). Institutional theory accounts for the diffusion of norms from high-income countries through global integration, which tends to foster isomorphism rather than pluralism (DiMaggio & Powell, 1983). While these approaches shed light on structural forces, they pay limited attention to how individual researchers navigate them.

In contrast, many frameworks of international collaboration—such as scientific capital (Bourdieu, 1986; Bozeman & Boardman, 2014), network theory (Wagner & Leydesdorff, 2005), and proximity approaches (Boschma, 2005; Frenken et al., 2009)—operate at the meso- and micro-levels, highlighting collaboration dynamics and researchers' relational positioning. Yet, they often leave structural inequalities implicit or treat them as functional. Even when relational patterns are taken into account, these frameworks seldom explore how individual researchers, viewed through an agency-centered lens, strategically make decisions in the face of structural inequalities.

This thesis addresses this gap by integrating macro-structural and meso- or micro-level, agency-centered perspectives to develop a more comprehensive understanding of their dynamic interplay in shaping scientific collaboration

within contexts of scientific inequality. It examines how structural constraints and individual agency interact in shaping international science, emphasizing the system's dynamism—shifting actors, evolving relationships, and changing science policies unfolding across multiple trajectories.

To fully capture these dynamics, it is essential to recognize that research practices and science policy are mutually constitutive, continuously shaping one another (Sarewitz et al., 2004). Scientific knowledge is influenced by institutional contexts, societal values, and power relations, while simultaneously informing policy decisions, governance frameworks, and normative standards (Jasanoff, 2004; Longino, 1990). This reciprocal relationship highlights the importance of analyzing international scientific collaboration not only as a research practice but also as a policy-relevant process—a perspective this thesis adopts.

Inequalities in science persist along multiple, intersecting dimensions, including but not limited to gender (Sugimoto & Larivière, 2023; Zhang et al., 2023; El-Ouahi & Larivière, 2023; Pradier et al., 2024; Schaer et al., 2017; Tomassini, 2021), race and ethnicity (Cech et al., 2017; Dupree & Boykin, 2021; Graves et al., 2022), parenthood and caregiving responsibilities (Charlesworth & Banaji, 2019; Infanger & Lima, 2019; Ogbogu, 2011; Staniscuaski et al., 2021), and socio-economic background (Demeter, 2019; Morley et al., 2018). These intersecting dimensions are further shaped by the primary focus of this thesis: scientific inequality between high-, middle-, and low-income countries.

In this context, international research collaboration can be seen as both a reflection of and a response to global scientific inequality, constituting a two-sided phenomenon. On the one hand, such collaborations provide researchers in low- and middle-income countries with access to resources, infrastructure, and publication opportunities that may be limited in their local contexts (Kwiek, 2020). For many in peripheral regions, limited national funding, underdeveloped research infrastructure, and barriers to publishing act as strong incentives to engage with partners based in more resource-abundant settings, creating opportunities to redistribute resources and broaden participation (Grieve & Mitchell, 2020; Muriithi et al., 2018; Wight et al., 2014). On the other hand, these partnerships risk reinforcing structural inequalities—especially when decision-making power, agenda-setting authority, and recognition remain concentrated in wealthier institutions (Alatas, 2022; Boum et al., 2018; Voller et al., 2022). Bearing both promise and risk, international collaborations have become a central focus of science policy and global

research funding initiatives (Bradley, 2017; Moyi Okwaro & Geissler, 2015; Wagner et al., 2001).

Inequalities in resources and opportunities shape not only motivations to collaborate but also barriers to collaboration and the dynamics within collaborations themselves. Partnerships between high- and lower-income countries are often criticized for unequal divisions of scientific labor (Gunasekara, 2020; Mbaye et al., 2019; Okeke, 2016), asymmetries in agenda-setting (Abimbola, 2019; Bradley, 2008; Chinchilla-Rodríguez et al., 2019), and the extent to which collaborations achieve mutual benefit and reciprocity (Dean et al., 2015; Matenga et al., 2019; Tilley & Kalina, 2021).

Science policy both reflects and shapes patterns of inequality in global science. For instance, through science diplomacy, countries use international collaboration to strategically position themselves and advance national interests (Echeverría-King et al., 2023; Flink & Schreiterer, 2010; Rüland et al., 2023). Additionally, researcher mobility shapes the conditions under which individuals and institutions can build capacity and overcome unequal structures (Doh & Jauhiainen, 2021; Jacob & Meek, 2013; Orazbayev, 2017; Stephan & Levin, 2001). Moreover, research capacity building represents a funding strategy designed to strengthen research systems in scientifically lagging regions through investments in infrastructure, training, and institutional development (Beran et al., 2017; Madsen & Adriansen, 2020; Wagner et al., 2001). Notably, science policy is not neutral: depending on its design and implementation, it can either reproduce existing inequalities or contribute to their reduction.

Existing empirical evidence on inequality in scientific collaboration remains largely confined to two predominant levels of analysis: large-scale quantitative studies—typically based on bibliometric data (Boshoff, 2010; Chinchilla-Rodríguez et al., 2019; Confraria et al., 2017; Czaika & Orazbayev, 2018; Gonzalez-Brambila et al., 2013; Pradier et al., 2024; Ynalvez & Shrum, 2011)—and qualitative case studies, which often focus on either extreme cases of dysfunction or exemplary best practices (Asare et al., 2020; Bradley, 2008; Gunasekara, 2020; Koch et al., 2025; Kontinen & Nguyahambi, 2020; Matenga et al., 2019; Munung et al., 2017). Bridging this divide through a multi-method approach, the empirical design of this thesis—mirroring its theoretical framework—seeks to connect macro-structural patterns with situated, team-level dynamics.

Following Sayer (2000), critical social science combines explanation with evaluation, seeking to identify and challenge the social constraints that hinder

human flourishing. From this perspective, scientific inequality between high-, middle-, and low-income countries undermines both the capacity of science and the promise of international collaboration to respond effectively to urgent global challenges. Despite unprecedented growth in global knowledge production, a persistent disconnect remains between research priorities and some of the most pressing problems confronting humanity—such as unmet health needs, basic human development, and environmental crises (Arocena & Sutz, 2021; Heeks et al., 2014; Jasanoff, 2007). Hierarchies in knowledge production give rise to epistemic injustices, shaping not only which issues are explored but also whose perspectives are considered valuable (Crane, 1967; Fricker, 2007; Bhakuni & Abimbola, 2021). Those most directly affected by crises—particularly in low- and middle-income countries—often have the least access to the scientific and financial resources required to address them (Fonseca et al., 2018; Kyobutungi et al., 2021; Yegros-Yegros et al., 2020). This misalignment between global research efforts and societal needs has prompted growing calls for a new generation of science policy centered on tackling grand societal challenges (Kuhlmann & Rip, 2019; Schot & Steinmueller, 2018).

The future of scientific collaboration is an ongoing process shaped by current practices and shared aspirations. One way to envision its direction is through the lens of expanding human freedoms and capabilities (Arocena et al., 2018; Sen, 1999; Walker, 2024). Sen's (1999) conception of development as the expansion of individuals' and communities' capabilities offers a foundation for understanding how science can advance broader societal goals—particularly by enabling people to live lives they value. Building on this, Arocena and Sutz (2021) describe capability expansion as a continuous process of strengthening individual and collective capacities without compromising opportunities for future generations. From this perspective, the value of science lies not only in the knowledge it produces but also in the inclusiveness of its practices and the societal relevance of the problems it addresses (Heeks et al., 2014; UNESCO, 2021; Wakunuma et al., 2021).

In sum, this thesis examines international scientific collaboration in the context of scientific inequality between high-, middle-, and low-income countries. By shedding light on the interplay between structure and agency, it aims to bridge—both theoretically and empirically—macro-level structures and meso- or micro-level team dynamics. Furthermore, by taking into consideration how science policy sustains or mitigates inequality in global research, the thesis provides a foundation for envisioning more inclusive pathways for future

international collaboration. The following section outlines the research aims and guiding questions that drive this investigation.

1.1. Research Aim and Research Questions

This thesis critically examines how international research collaborations both reflect and respond to scientific inequalities between high-income and low- and middle-income countries, analyzing the interplay between structure and agency in shaping collaboration practices. It further investigates the role of science policy in sustaining or mitigating these inequalities within global science. The study is guided by two main research questions:

- i. How do practices within international scientific collaboration reflect and respond to structural inequalities?
- ii. How does science policy sustain or mitigate inequality in global research collaboration?

The research questions, and how they aim to capture the interplay between scientific inequality and collaboration, as well as between structure and agency, are illustrated in Figure 1.

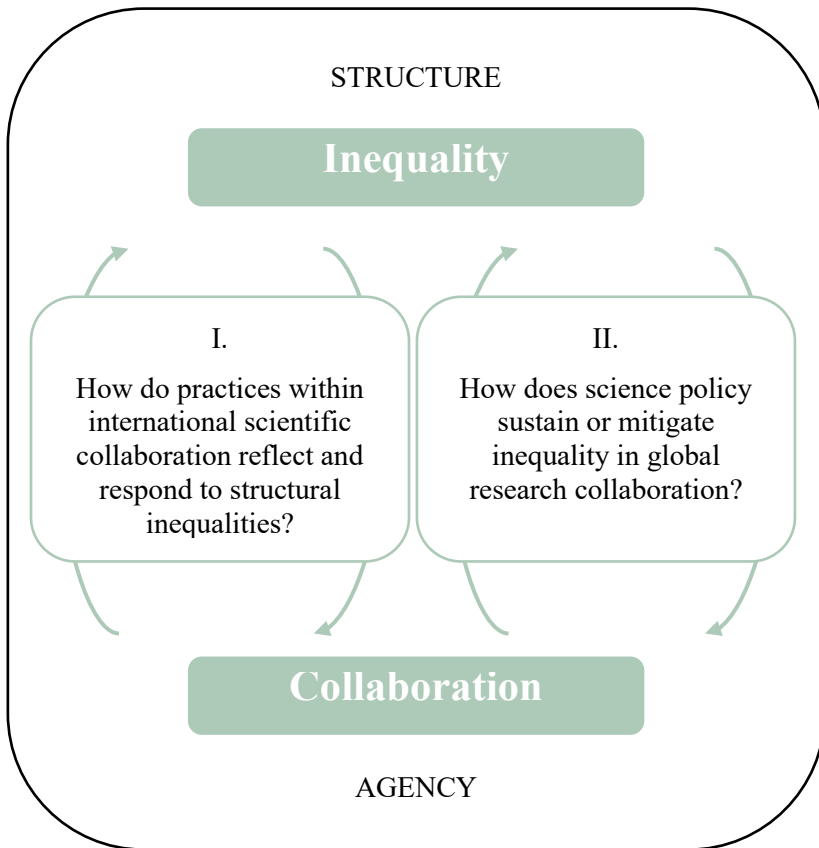


Figure 1. Research questions guiding the study, examining how scientific practices and policies shape the interplay between inequality and collaboration (own depiction).

1.2. Contribution

This thesis makes a threefold contribution to the study of inequality in international scientific collaboration:

Theoretically, it employs a critical realist perspective that attends to both the structure of inequality and the agency of actors navigating it. In doing so, it addresses the limitations of macro-level frameworks, which tend to explain inequality in science as a static outcome of structural conditions. Such theories often fail to account for how researchers actively engage with and act within

these systemic structures. By highlighting team dynamics within international scientific collaboration, this thesis contributes a dynamic understanding of how persistent inequality is navigated and experienced in scientific practice. Moreover, the thesis aims to bridge macro-level structural theories with meso- and micro-level agency-focused perspectives, contributing to a discussion that acknowledges both enduring legacies and the situated ways in which researchers react to them.

Empirically, the study aims to bridge a divide in existing research on inequality in science, which is largely split between quantitative studies, such as bibliometric or network analyses, and small-scale qualitative case studies that typically depict either highly successful or highly problematic collaborations. By combining both approaches and various units of analysis, the thesis captures both structural patterns and lived experiences, providing a nuanced understanding of international team science. By employing a multi-method design, it combines conceptual, quantitative, and qualitative studies to investigate inequality from various angles and bridges gaps and limitations within the respective traditions.

Practically, this research emphasizes the role of science policy in shaping patterns of inequality in international science. By examining how policies influence collaboration dynamics, the thesis provides insights into the link between science policy and scientific practice. These insights are relevant for a range of actors, including policymakers, research institutions, publishers, and researchers. For researchers, understanding their own position within global scientific structures and in relation to colleagues can support more strategic and equitable engagement in international collaboration.

2. Literature Review

This thesis critically examines how international scientific collaboration both reflects and responds to structural inequalities among high-, middle-, and low-income countries. It investigates the dynamic interplay between structural forces and individual and collective agency in shaping collaboration practices and considers the role of science policy in sustaining or mitigating these disparities.

The literature review integrates different strands of scholarship on inequality in science, distinguishing two complementary perspectives, as illustrated in Figure 2. Macro-structural approaches emphasize systemic hierarchies that shape opportunities and outcomes in science, often adopting a rather deterministic view of inequality. In contrast, meso- and micro-level frameworks—commonly applied to research collaboration—focus on relational dynamics. This thesis employs these frameworks from an agency-centered perspective, focusing on how researchers strategically navigate inequality through their actions and choices. By bridging these perspectives, the analysis captures both the structural conditions and the situated dynamics that shape global research partnerships.

Finally, the review considers the role of science policy, examining the dualities between science and society, policy and practice, and self-organization and formal institutions. This perspective enables an exploration of how science policy can either sustain or mitigate unequal structures, and how it shapes individual and collective responses within global collaborations.

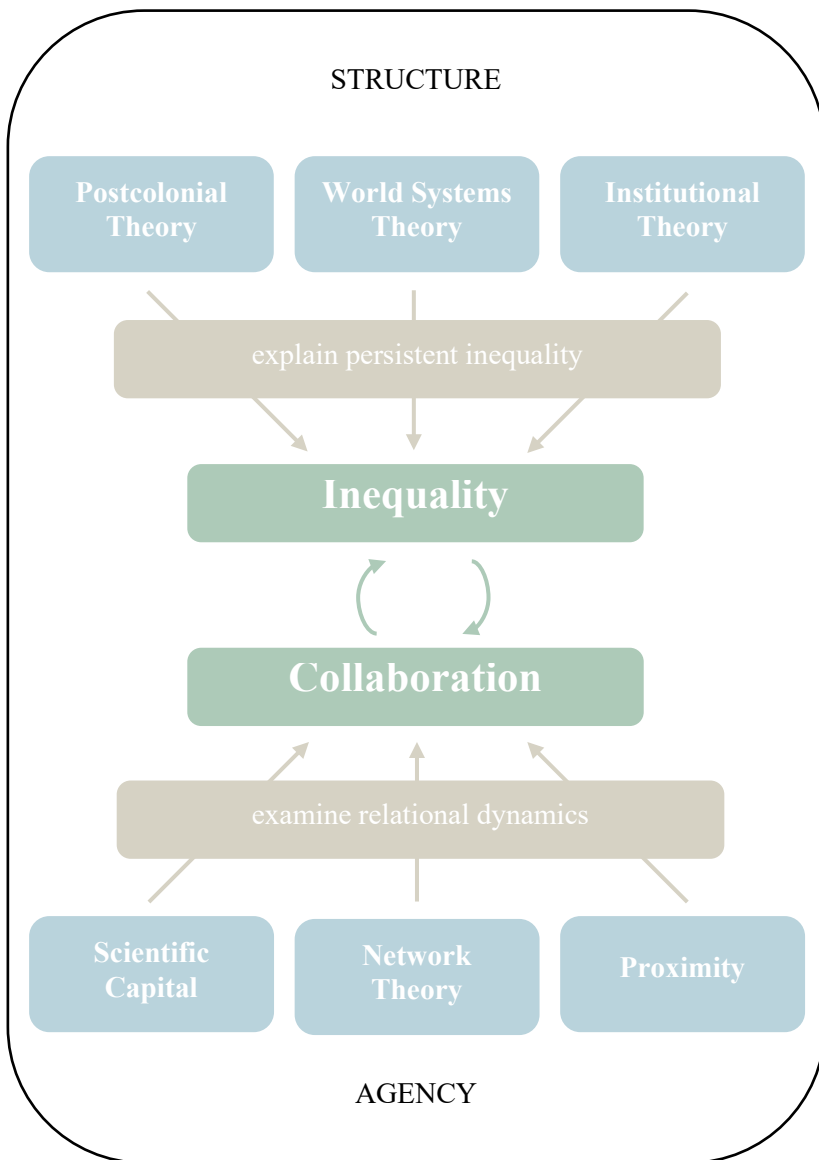


Figure 2. Theoretical perspectives linking structure, agency, and inequality in scientific collaboration (own depiction).

2.1. Macro-Structural Perspectives on Inequality in Science

Understanding inequality in global scientific collaboration requires situating it within the broader theoretical traditions that explain systemic disparities in science. Macro-level frameworks—including postcolonial, world-systems, and institutional theory—highlight how enduring colonial legacies, global hierarchies, and institutional arrangements reproduce asymmetries in scientific capacity, participation, and recognition. Together, these perspectives offer valuable insights into the persistence of structural inequality in global science.

2.1.1. Postcolonial Theory

Postcolonial theory offers a critical framework for understanding how colonial legacies and neo-colonial power relations continue to shape global science, embedding structural hierarchies in the production and circulation of knowledge. It foregrounds the epistemic dominance of Western science, where Eurocentric worldviews continue to define what counts as legitimate knowledge, often at the expense of diverse and situated ways of knowing (Harding, 2009; Mignolo, 2011; de Sousa Santos, 2014). Consequently, the global scientific system is not merely unequal in terms of resources and visibility but also in whose knowledge is recognized, legitimized, and circulated.

Central to postcolonial critiques is the notion of epistemic injustice—the marginalization of knowledge systems and practices rooted outside the historical centers of scientific authority (Bhakuni & Abimbola, 2021; Fricker, 2007). The diffusion of Western and Northern norms has often involved the devaluation of alternative epistemologies or “Southern theory” (Connell, 2014; Vessuri & Cancino, 2018), resulting in what some scholars term cognitive imperialism (de Sousa Santos, 2014; Quijano, 2000). However, while calls to recognize “the local” provide an important corrective, scholars have warned against idealizing local knowledge or essentializing communities in the Global South as internally homogenous or culturally static (Escobar, 1995; Moosavi, 2020). Local actors often operate within complex constraints, navigating internal power hierarchies, and making pragmatic decisions that reflect both structural limitations and individual agency (Bradley, 2008; Walker & Martinez-Vargas, 2022).

As a result of the marginalization of Southern or subaltern voices, postcolonial scholars have long criticized the dominance of Northern epistemologies and the exclusion of alternative knowledge systems (Connell, 2014; de Sousa Santos, 2014; Moosavi, 2020). At the same time, postcolonial theory itself contains important self-critiques of binary representations that risk reproducing the very hierarchies they seek to challenge. As Mohanty (2003) and Spivak (1988) argue, portraying actors from high-income countries as either saviors or exploiters, and those from low- and middle-income countries as passive subjects, oversimplifies a complex reality. Such framings risk essentializing both sides and obscuring the nuanced, negotiated, and often contradictory experiences of researchers working across global divides (Bradley, 2008).

Postcolonial critiques have also been challenged for their limited engagement with pathways toward institutional or material transformation. As Fraser (1990) notes, critical theory risks becoming overly abstract or detached from concrete political struggles, often neglecting the practical conditions under which change occurs. Similarly, calls for “delinking” from global systems of knowledge production (Mignolo, 2011) represent a powerful form of epistemic resistance but may overlook the pragmatic realities and strategic choices of researchers who continue to engage in international collaborations—whether for access to resources, recognition, or the pursuit of shared scientific goals (Munung et al., 2017; Muriithi et al., 2018).

This study adopts a critical realist orientation that builds on postcolonial insights while foregrounding both individual and collective agency. It examines how researchers across different contexts engage in collaboration and navigate entrenched structural asymmetries in the process. In doing so, it seeks to bridge structural explanations of inequality with an agency-centered understanding of how actors strategically and reflexively operate within, and sometimes against, these unequal systems.

2.1.2. World Systems Theory

The overall power structure of the global research system appears largely inert. Scholars drawing on world-systems theory describe a persistent core-periphery structure, marked by a concentration of resources in the center and a steady supply from peripheral areas (Demeter, 2019; Schott, 1998). Scientific resources tend to cluster in core countries, attracting attention and mobile researchers from more peripheral contexts (Confraria et al., 2017; Verginer & Riccaboni, 2020). Core regions are often characterized as self-reliant and

inward-looking, while peripheral regions are more dependent on their ties to the center (Boshoff, 2009).

Core-periphery structures are observable at multiple scales, including national and regional levels. Globally, a small group of countries—primarily in North America, Western Europe, and parts of East Asia—constitute the centers of the global scientific system, with peripheries located across Asia, Africa, Latin America, and Eastern Europe (Demeter, 2019). To introduce greater nuance, scholars have proposed the concept of *semi-peripheries* to reflect a more differentiated global research landscape (Hwang, 2008; Schubert & Sooryamoorthy, 2010). Semi-peripheries refer to countries or regions that perform core-like functions in relation to more peripheral areas while simultaneously occupying peripheral positions in relation to the core.

Although it illuminates the persistence of structural inequalities in global science and acknowledges nuance through the concept of semi-peripheries, world-systems theory ultimately maintains a largely deterministic view of global hierarchies. This limits its ability to account for the dynamic and evolving nature of the contemporary scientific system (Adams & Szomszor, 2022; Czaika & Orazbayev, 2018; Oldac, 2023). In recent decades, key trends, such as the global expansion of science, increasing pluralization, and relative shifts in scientific hierarchies, have been observed (Marginson, 2020; Wagner et al., 2015; Aksnes & Sivertsen, 2023). These developments are driven by a range of factors, including increasing specialization, the integration of complementary knowledge and resources, and the pursuit of enhanced productivity through collaboration (Dusdal & Powell, 2021; Katz & Martin, 1997). In many contexts, the growth of scientific output has been facilitated by significant investment in research and development (Schot & Steinmueller, 2018).

While world-systems theory helps explain the endurance of structural asymmetries, it may be less suited to capturing simultaneous processes of change—particularly the growing multipolarity in the global research landscape (Shih, 2024). Countries with historically marginal roles are expanding their scientific capacity and influence (Adams & Szomszor, 2022), while others are withdrawing from international collaboration (Lynch & Goldenberg-Hart, 2021). The global scientific system's center of gravity is gradually shifting, most notably eastward, with China's emergence as a major scientific power (Czaika & Orazbayev, 2018; Oldac, 2023; Adams et al., 2022). Although scientific production has become more spatially distributed, gains in recognition and visibility often lag behind (Radosevic & Yoruk, 2014). The increasingly multipolar system thus retains forms of dominance—now

more distributed and characterized by evolving configurations of power and subordination (Benner, 2018). Deep inequalities in research capacity and output persist, closely tied to countries' income levels (Das et al., 2013).

Overall, while world-systems theory helps explain broad structural patterns and persistent inequalities in global science, it offers limited insight into the dynamic processes and recent shifts in the scientific landscape. It captures structural constraints but provides little understanding of how actors exercise agency within these hierarchies.

2.1.3. Institutional Theory

Institutional theory is often used to explain the persistence of established norms and practices in the global scientific system (Powell & Colyvas, 2008). This lens highlights how norms, practices, and organizational logics shape behavior and reinforce existing hierarchies within the scientific system. In contrast with structural perspectives that emphasize distributions of power, institutional theory shifts the focus toward the norms, routines, and practices that shape behavior within systems. In the context of international science, this perspective helps explain why certain practices and hierarchies persist—even in a science system that is expanding and diversifying (Adams & Szomszor, 2022). By examining how institutions operate and how norms are diffused, this approach can provide insight into the mechanisms that reproduce inequality in global research.

Institutions can be formal—such as funding rules, publication practices, and hiring norms—or informal, including social norms, unconscious biases, habitus, and established habits (Crane, 1967; Dupree & Boykin, 2021; Kozłowski, 2023; Walsh et al., 2016; Koch et al., 2025). While formal institutions shape the external conditions under which research is conducted, informal norms and behaviors often operate less visibly but with significant influence. Both types of institutions are continually reproduced through everyday practices, thereby potentially reinforcing enduring structures of inequality. At the same time, however, institutions—especially but not only informal ones—can create spaces for individual researchers to exercise agency and, in doing so, modify established relations and practices.

A key concept within institutional theory is institutional isomorphism, which describes the tendency of collaborating organizations to grow increasingly similar over time due to normative, mimetic, and coercive pressures (DiMaggio & Powell, 1983). In international science, these pressures manifest

in the widespread adoption of publishing standards, evaluation metrics, and institutional models developed in dominant high-income countries. As scientific institutions in low- and middle-income countries strive for legitimacy and recognition, they often emulate these dominant standards (Gaillard, 2010). This diffusion of norms reinforces the authority of institutions in the global core and often leads to conformity.

Moreover, this process often unfolds asymmetrically. While institutions in peripheral regions may adopt the practices of the center, the reverse is rare, and recognition remains unevenly distributed. For instance, publishing in English-language, high-impact journals remains a near-universal benchmark, even though such outlets are concentrated in a small number of countries and may privilege certain epistemologies and research agendas (Chavarro et al., 2017; Collyer, 2018; Demeter, 2019). As a result, institutional norms function not only as a means of integration into global science but also as mechanisms of exclusion and stratification (Akbaritabar et al., 2024). This contributes to the durability of global hierarchies, as peripheral actors are structurally encouraged to conform to dominant standards while receiving less visibility and credit for their contributions.

However, institutional theory has also been critiqued for its limited attention to agency, change, and micro-level enactments in social situations (Powell & Colyvas, 2008). Its focus on path dependency and the reproduction of norms can lead to an overly static view of the scientific system, underestimating the capacity of actors to resist, reinterpret, or transform institutional logics (Sewell, 1992; Emirbayer & Mische, 1998). This critique highlights that individuals and groups in both central and peripheral regions possess the agency to navigate, challenge, and reshape existing structures, changing institutions even while operating within them (Powell & Colyvas, 2008).

In sum, institutional theory helps to explain how norms and practices within global science are sustained and replicated across contexts, contributing to persistent hierarchies. At the same time, recognizing the role of agency within this framework reveals that these structures are not immutable.

2.1.4. Beyond Structure

Macro-structural theories of inequality offer valuable insights into the persistence of disparities within the contemporary scientific system. They illuminate how colonial legacies, hierarchies, and entrenched institutional

forces continue to shape asymmetries in global science. Yet, these perspectives fall short in addressing three dimensions:

- i. Dynamism: The scientific system is not static but marked by constant flux—including the emergence and withdrawal of actors, shifting relationships, and evolving policy frameworks.
- ii. Situatedness: Researchers navigate macro-structural inequalities in highly context-specific ways, shaping career trajectories, everyday research practices, and the dynamics of collaboration within teams composed of individuals with diverse identities and interests.
- iii. Agency: Researchers – individually or collectively – possess varying degrees of agency that enable them to resist, adapt to, or actively transform structural conditions, depending on their position and power within the system.

This thesis extends existing theories of inequality by foregrounding these dynamics, highlighting the situated practices of researchers, and emphasizing the role of agency in shaping global scientific collaboration.

2.2. Meso- and Micro Perspectives on International Scientific Collaboration

Against the backdrop of stabilizing forces that sustain unequal structures in global science, researchers—both individually and collectively—exercise agency in navigating these hierarchies (Walker & Martinez-Vargas, 2022). Scientific knowledge production, as a fundamentally social process, is shaped by the interactions, positions, and relationships among participants (Merton, 1973; Longino, 1990). Understanding how inequalities are resisted, adapted to, and occasionally transformed requires attention to the agency-centered mechanisms that shape collaboration in practice.

To examine how researchers respond to structural inequalities, this section employs key concepts for analyzing relational dynamics in international collaboration—scientific capital, networks, and proximity—through an agency-centered lens. This approach shows how researchers actively navigate unequal structures. In doing so, the thesis highlights how researchers construct and negotiate collaboration strategies and team dynamics in response to these inequalities.

2.2.1. Scientific Capital

One of the key concepts for understanding collaboration dynamics is scientific capital (Koch et al., 2025; Walsh et al., 2016). This section explores how the uneven distribution of scientific capital not only shapes why researchers engage in collaboration—often to access or augment such capital within a globally unequal science system—but also how they pool or exchange these resources within collaborative settings.

According to Bourdieu (1986), different forms of capital take time to accumulate, tend to persist within individuals, and significantly influence their chances of success. Capital reflects underlying social structures, shaping power relations and institutional hierarchies (Demeter, 2019). In the global system of knowledge production, scientific capital includes access to material resources, individual skills and expertise, and forms of recognition embedded in the norms and values of scientific fields (Bozeman & Boardman, 2014).

Material capital—such as research funding, infrastructure, and institutional support—is unequally distributed across countries. High-income countries benefit from significantly greater national investments in science (Petersen, 2021; Sridhar, 2012), leading to larger academic workforces and more time for research relative to other obligations such as teaching or consulting (Kontinen & Nguyahambi, 2020; Muriithi et al., 2018; Wight et al., 2014). Infrastructure for “big science” remains concentrated in core regions of the global research system, with limited and only gradual expansion elsewhere (Lehuedé, 2023; Munung et al., 2017; Okeke, 2016; Rüland et al., 2023). Funding flows from institutions in high-income countries to institutions in lower-income countries can serve to redistribute resources but may also reinforce existing dependencies (Grieve & Mitchell, 2020; Brodén Gyberg, 2023; Alatas, 2022).

Embodied scientific capital refers to the knowledge, skills, and competencies researchers accumulate through education, training, and professional experience (Tetteh et al., 2020). It includes disciplinary expertise, methodological proficiency, familiarity with academic publishing norms, and proficiency in English as the dominant language of science (Salager-Meyer, 2008). These capacities are unevenly distributed, reflecting disparities in access to education, mentorship, and institutional support (Doh & Jauhiainen, 2021). Embodied capital is commonly signaled through academic degrees, institutional affiliations, publication records, and citation counts, which, in turn, shape researchers’ visibility and perceived credibility within the scientific community (Chavarro et al., 2017; Demeter, 2019).

Symbolic capital refers to the prestige and recognition conferred by these signals. It tends to accumulate among already well-established researchers, reinforcing the “Matthew effect” and creating cumulative advantages over time (Merton, 1973). The distribution of symbolic capital is shaped by institutions that serve as gatekeepers of scientific legitimacy, such as academic publishers, journals, and universities. Notably, 70% of academic publishers are based in North America and Europe, giving these regions disproportionate influence over what is considered “good” science and which audiences are prioritized (Collyer, 2018; Crane, 1967; Abimbola, 2019; Sridhar, 2012). As a result, hierarchies of scientific prestige are closely aligned with institutional and national affiliations (Gerhards et al., 2018). Recognition in the form of degrees, publications, institutional affiliations, and citations functions as symbolic capital (Collyer, 2018; Demeter, 2019). While mechanisms such as peer review, editorial decisions, and hiring practices aim to uphold quality standards, they are also shaped by subjective judgments and existing power structures, often reinforcing the positions of already established researchers (Crane, 1967; Dupree & Boykin, 2021; Longino, 1990). These inequalities can give rise to epistemic injustices, wherein certain voices, perspectives, and problems are systematically undervalued or excluded from the global knowledge agenda (Bhakuni & Abimbola, 2021; Fricker, 2007).

In accumulating material, embodied, and symbolic forms of scientific capital, researchers navigate a system marked by unequal access to resources, recognition, and opportunities. They often make strategic decisions about collaboration and mobility based on these opportunities, making international partnerships a key mechanism for pooling, exchanging, and developing capital. While such collaborations can redistribute and integrate complementary resources, they may also disproportionately benefit well-resourced centers, thereby reinforcing existing global scientific inequalities.

2.2.2. Network Theory

Because knowledge production is inherently social, networks constitute a fundamental structure for the exchange of scientific capital among researchers (Melin, 2000; Wagner et al., 2015). This is particularly important in an increasingly globalized scientific system, where collaborations commonly span national boundaries. Researchers’ collaborative ties are further expanded through mobility, reinforcing the role of networks in shaping access to resources and opportunities (Leung, 2013). Within this context, researchers

strategically leverage their networks—acting as connectors, brokers, or intermediaries—to enhance collaboration (Llopis et al., 2021).

Collaborative network ties encompass not only joint research resulting in co-publications but also diverse forms of exchange—such as sharing advice, resources, or citations—that establish and sustain collaborative relationships within scientific networks (Katz & Martin, 1997). Within disciplines or research fields, researchers form social circles or “invisible colleges,” characterized by direct and indirect interactions, shared traits, and varying openness to outside influences (Crane, 1967). Such networks display shared, often implicit, behavioral patterns among members (Adams & Szomszor, 2022), which can spread through processes of institutional isomorphism.

In the global research system, network ties represent a valuable form of capital for accessing and producing new knowledge (Gonzalez-Brambila, 2014). Beyond knowledge production, networks also facilitate professional opportunities and external recognition (Ynalvez & Shrum, 2011). Although dependent on discipline and research focus, collaboration—particularly international—is generally associated with greater visibility and productivity for researchers (Martinez & Sá, 2020; Ubfal & Maffioli, 2011; Subramanyam, 1982). Consequently, research networks tend to grow asymmetrically through preferential attachment, where central and influential actors attract more connections (Glänzel, 2001; Vieira, 2022; Wagner & Leydesdorff, 2005), reinforcing the “Matthew effect” (Merton, 1968).

Geographically, global research networks are highly concentrated around scientific hubs, with researchers from North America and Europe often serving as central nodes in collaboration and citation networks (Boshoff, 2009; Confraria et al., 2017; Dosso et al., 2023; Lemarchand, 2012; Mégnigbêto, 2013; Pasterkamp et al., 2007; Sweileh, 2022). In contrast, authors from African, Latin American, and many Asian countries remain underrepresented in authorship patterns (González-Alcaide et al., 2017; Hedt-Gauthier et al., 2019; Mbaye et al., 2019; Zhou et al., 2020). Affiliation with core countries also correlates with higher citation rates, giving these countries disproportionate influence (Bonitz et al., 1997). While global collaboration networks are expanding, leading to some convergence, countries with strong national research systems continue to dominate central positions and preferentially collaborate among themselves (Adams & Szomszor, 2022; Gazni et al., 2012; Leydesdorff & Wagner, 2008). Within the heterogeneous groups of middle- and low-income countries, significant disparities remain between those rapidly integrating into international networks and those that continue to be marginalized (Dosso et al., 2023; Radosevic & Yoruk, 2014).

At the network level, stabilizing forces sustain a persistent core–periphery dynamic, with institutional processes spreading dominant norms. Features such as preferential attachment reinforce these asymmetries, concentrating resources in the core. Yet global research networks are dynamic and expanding. While this growth is not necessarily equitable, it can facilitate the inclusion of previously marginalized regions. As the main organizational form of contemporary science, collaborative networks both reinforce asymmetries and provide channels for redistributing resources across high-, middle-, and low-income countries.

2.2.3. Proximity

Another crucial social mechanism that sheds light on how scientific capital is exchanged within collaborations and circulates through research networks is proximity. Initially, the concept of proximity was primarily understood in terms of geographic closeness—how physical distance between researchers or institutions influences the likelihood of collaboration (Katz, 1994). However, over time, this notion has been broadened considerably to encompass multiple dimensions, including cognitive, social, organizational, and institutional proximity (Boschma, 2005; Frenken et al., 2009; Balland, 2012).

Each dimension highlights a different facet of the collaborative process. Cognitive proximity, for example, relates to the similarity of knowledge and expertise, enabling researchers to communicate effectively and build on each other's ideas (Boschma, 2005). Social proximity refers to interpersonal relationships and trust, which reduce uncertainty and foster cooperation (Nilsson, 2019). Organizational and institutional proximities concern the extent to which researchers share affiliations or operate under similar norms, rules, and incentives (Frenken et al., 2009; Hoekman et al., 2010; Ponds et al., 2007). These dimensions often point to an optimal “medium range” of proximity: collaborators need to be sufficiently close to understand one another and coordinate efficiently, yet distant enough to access diverse perspectives and recombine ideas in novel ways (Frenken et al., 2009; Boschma, 2005).

Moreover, proximity is dynamic rather than static and evolves through collaboration itself (Balland et al., 2015). As researchers work together, they may strengthen social ties based on trust, deepen cognitive proximity through mutual learning and intellectual exchange, or experience shifting needs for proximity that are temporary or context-dependent (Hautala, 2011; Hautala & Schmidt, 2019; Nilsson, 2019; Torre, 2008; Werker & Ooms, 2020). This

dynamic interplay renders proximity both a prerequisite for collaboration and one of its outcomes.

In sum, proximity provides a valuable lens for examining the relational mechanisms underlying scientific collaboration in an unequal global system. It illuminates how dimensions of closeness and distance structure opportunities for interaction, learning, and trust. At the same time, it often abstracts from the structural inequalities that shape these relationships—overlooking how material, institutional, and geopolitical asymmetries shape the very possibilities for proximity to emerge.

2.2.4. Centering Agency

Micro- and meso-level theories widely applied to the study of international collaboration—such as scientific capital, social network theory, and proximity—offer valuable frameworks for understanding the relational dynamics of research partnerships. However, they address several important dimensions only partially.

- i. **Inequality:** While scientific capital and social network theory inherently—though often implicitly—engage with inequality, they tend to conceptualize it as a functional or inevitable outcome of collaborative processes. The concept of proximity, by contrast, largely overlooks structural inequality altogether.
- ii. **Agency:** These approaches describe mechanisms and dynamics of collaboration but seldom place individual researchers at the center as active agents who navigate constraints and make deliberate collaboration choices.
- iii. **Indeterminism:** Consequently, collaborative processes are often portrayed as predetermined, underplaying researchers' capacity—individually or collectively—to resist, adapt to, or actively transform structural inequalities.

This thesis employs these theories through an agency-centered lens, highlighting their strategic character by focusing on researchers as agents who actively navigate the unequal structures of the global science system.

2.3. The Role of Science Policy

After outlining structural and agency-centered theories explaining scientific inequality among high-, middle-, and low-income countries—and discussing how international collaboration responds to these dynamics—the next section examines the role of science policy. Science policy shapes structural conditions by defining formal relations, rules, incentives, as well as allocating resources that shape the global research system. At the same time, it establishes the framework of actors' agency by influencing the opportunities and constraints individuals face when navigating their scientific work. The following review of science policy explores these dynamics, emphasizing the dualities between science and society, science policy and scientific practice, as well as researchers' self-organization within formal institutions.

Science is deeply embedded in society. While it holds a privileged position in shaping knowledge and informing decision-making, it remains a social practice governed by norms and values that reflect broader societal power relations (Longino, 1990), including inequalities along various dimensions (Kozlowski, 2023). Scientific knowledge is shaped by how it is organized, managed, and applied—and these processes are shaped by public policy (Benner, 2018). Science policy, broadly defined, refers to the processes through which intellectual and financial resources are allocated to research, often through decisions made by governments, funding bodies, and academic institutions (Sarewitz et al., 2004). These policies influence not only how science is practiced but also how it evolves over time, with research practices and governance co-evolving in dynamic ways (Benner, 2018).

Science policy unfolds across multiple, overlapping layers—global, national and regional, institutional, and individual. Science and science policy are thus shaped by interactions at all these levels, establishing formal and informal institutions. Actors at each level establish the rules and incentives that govern research activities (Frenken et al., 2009).

At the global level, these actors include scientific publishers, editorial boards, peer-review processes, international organizations, philanthropic foundations, and multilateral funding agencies such as the WHO (Collyer, 2018; Sridhar, 2012; Brattström, 2023). At the national and regional level, institutions are shaped by governmental research policies, national funding agencies, research councils, or multilateral organizations such as the European Commission (Bauder, 2015; Hoekman et al., 2010; Mattsson et al., 2010). While national research systems develop their own policies and funding mechanisms, they

remain embedded within the global scientific system, producing a dynamic interplay between domestic priorities and international scientific norms (Adams & Szomszor, 2022; MacHáček et al., 2022; Wagner et al., 2015; Yongabo, 2021; Acevedo, 2018). At the institutional level, universities and research organizations establish internal rules, incentive structures, and organizational cultures that shape how research is conducted and valued (Thoenig & Paradeise, 2016; Whitley, 2012; Arocena et al., 2015). Taken together, these institutions often exert a homogenizing influence on research organization and practices across different contexts (Benner, 2018). Finally, at the individual level, researchers navigate these multi-layered institutional environments by interpreting and responding to both formal rules and informal expectations. Their actions are characterized by a high degree of self-organization, guided by personal interests but shaped within the broader structures of the scientific system (Wagner & Leydesdorff, 2005; Mattsson et al., 2010; Sugimoto et al., 2017).

Finally, institutions not only reflect prevailing conditions but can also serve as sites of change. Kuhlmann and Rip (2019) argue that addressing global inequality requires systemic transformation, including shifts in science policy. Science policy thus holds the potential not only to shape knowledge production but also to influence broader societal trajectories (Sarewitz et al., 2004). Decisions in this realm can shape how science contributes to more equity or, conversely, reinforces exclusion—underscoring the importance of critically examining both the design and implications of scientific institutions (Benner, 2018).

2.3.1. Science Policy and International Collaboration

International collaboration is increasingly pursued as a strategic means to access knowledge and strengthen a country's position in global science—an approach adopted by both high- and lower-income countries (Chu et al., 2014; Georgiou, 1998; Zhou et al., 2020).

In the context of persistent asymmetries among high-, middle-, and low-income countries, international research collaboration is particularly important to examine, as it simultaneously reflects and responds to global scientific inequality. Collaboration serves different functions depending on context: among high-income countries, it is often a means to share resources and address complex scientific challenges. In contrast, for many low- and middle-income countries (LMICs), collaboration may be a pathway to access

expertise, infrastructure, and funding that might otherwise be unavailable (Olechnicka et al., 2019).

Collaborations can, on the one hand, provide researchers in low- and middle-income countries with access to resources, infrastructure, and publication opportunities that may be scarce in their local contexts. For many researchers in peripheral regions, limited national funding, underdeveloped research infrastructure, and barriers to publishing create strong incentives to partner with institutions in high-income countries (Grieve & Mitchell, 2020; Muriithi et al., 2018; Wight et al., 2014). However, these partnerships also risk reinforcing structural inequalities—especially when decision-making power, agenda-setting, and recognition remain concentrated in the more well-equipped institutions. Reflecting both their promise and complexity, international collaborations have become a central focus of science policy and global research funding initiatives (Bradley, 2017; Moyi Okwaro & Geissler, 2015; Wagner et al., 2001; Aksnes & Sivertsen, 2023).

Over the past few decades, collaboration has emerged as a central focus of science policy, reflecting a broader shift toward viewing science as a global, interconnected system (Martin, 2016; Olechnicka et al., 2019). Policy initiatives increasingly target not only individual researchers or national projects but also actively promote international networks, making collaboration both a scientific practice and a strategic policy tool.

Science policy influences collaboration in direct and indirect ways. Directly, it may promote collaboration as a specific goal—for example, through the design of funding schemes. Indirectly, policies shape collaboration by creating institutional environments that either incentivize or disincentivize cross-border research (Olechnicka et al., 2019). Key mechanisms through which science policy shapes research collaboration include, but are not limited to, science diplomacy, researcher mobility, and research capacity building.

Science diplomacy refers to the ways states project their identities and interests within the international knowledge arena, influencing the framework within which countries engage in international collaboration (Olechnicka et al., 2019). It enables countries or regions to advance their scientific and political objectives (Flink & Schreiterer, 2010), providing those with sufficient resources the ability to engage strategically and secure advantageous positions. Low- and middle-income countries employ a variety of strategies within science diplomacy to enhance their scientific and political participation, build capacities, and facilitate international collaboration and researcher mobility (Echeverría-King et al., 2023; Rüländ et al., 2023). Simultaneously, science

diplomacy is considered vital for addressing global challenges—such as health and climate crises—that transcend borders and require pooling knowledge and scientific resources (Flink & Ruffin, 2019).

Researcher mobility plays a critical role in enabling international collaboration. By creating spatial and institutional linkages between researchers, mobility programs help build scientific networks. These programs—such as exchange fellowships, visiting professorships, and travel grants—are especially valuable for early-career scientists and those in resource-constrained settings. Countries pursue diverse strategies to send, attract, and re-attract researchers as part of broader collaboration and capacity-building agendas (Jacob & Meek, 2013; Saxenian, 2005; Siekierski et al., 2018). At the same time, mobility is unevenly constrained by visa and administrative barriers (Chinchilla-Rodríguez et al., 2018; Orazbayev, 2017) and intertwined with researchers' personal circumstances (Morley et al., 2018), resulting in unequal opportunities to pursue mobility as a career-building strategy.

Besides direct funding, collaboration is frequently employed as a strategy for research capacity building in LMICs (Chu et al., 2014; Dean et al., 2015). International partnerships may involve training components, institutional strengthening, or infrastructure development, as well as mentorship schemes, joint doctoral programs, and access to global research networks. As Wagner et al. (2001) note, capacity building through collaboration serves both scientific and developmental goals. However, due to inherent imbalances in these partnerships and the often one-directional flow of knowledge, capacity building practices have also been criticized for reinforcing dependency rather than fostering sustainable research systems (Alatas, 2022; Mormina & Istratii, 2021).

International collaboration has long been promoted as a cornerstone of scientific progress. It is driven both by researchers' self-organization within institutional incentive systems and by targeted policy measures such as science diplomacy, mobility programs, and capacity-building initiatives (Melin, 2000; Wagner & Leydesdorff, 2005). However, recent developments signal a shifting landscape: alongside these integrative efforts, a growing countercurrent has emerged, marked by skepticism and even backlash against cross-border scientific cooperation in the form of science nationalism (Gumaelius et al., 2025). Many countries—including HICs that previously invested heavily in international collaboration and developmental research with LMICs, such as the United States and Sweden—are currently reducing their commitments to such partnerships. Broader geopolitical dynamics further reflect a turn away

from collaboration, potentially ushering in a new era of hyper-competition and highly transactional approaches to science (Gumaelius et al., 2025). This evolving context underscores the increasingly complex and contested role of science policy in shaping the future of global research collaboration.

3. Research Design

Like any social system, the science system is open, complex, and “messy” (Sayer, 2000, p. 19; Longino, 1990), making it impossible to isolate components for controlled examination. Structure and agency are not separated but mutually influence each other (Bashiri, 2025), as agents act within structural constraints while simultaneously shaping those structures through their actions. Moreover, drawing on Sayer (2000), science policy can be seen as shaping both structure and agency: it not only defines structural conditions such as resource allocation and institutional incentives but also sets the constraints and possibilities within which individual researchers navigate the scientific system.

To capture these complexities, this compilation thesis consists of five separate studies that together explore research collaboration in the context of scientific inequality among high-, middle-, and low-income countries. Each study addresses a distinct aspect of collaboration, employing either conceptual, quantitative or qualitative methodologies, different theoretical perspectives, and varying levels and units of analysis. Taken as a whole, the thesis adopts a multi-method design, integrating these diverse approaches to provide a comprehensive understanding of inequality in global science. This approach aligns with a critical realist ontology.

3.1. Critical Realist Ontology of Inequality in Science

Critical realism, as articulated by Bhaskar (1975) and elaborated by Sayer (2000), views reality as stratified into three interconnected layers: the real, comprising the underlying structures and mechanisms that generate phenomena; the actual, referring to the events and processes these mechanisms produce; and the empirical, encompassing what is experienced or observed. When applied to scientific inequality across high-, middle-, and low-income

countries, this perspective highlights how structural hierarchies in knowledge production and institutional power (the real) shape the organization of collaboration (the actual), which is experienced and reflected by researchers and observable in authorship outcomes (the empirical), as illustrated in Figure 3. Recognizing this stratification allows for a nuanced understanding of how structural conditions both constrain and enable individual agency in international science. This ontological perspective also underpins the choice of a multi-method design: quantitative analyses help identify and map large-scale structures of inequality (capturing aspects of the real and actual), while qualitative approaches provide insight into lived experiences and agency within collaborations (the empirical), together offering a more comprehensive understanding of the mechanisms driving inequality.

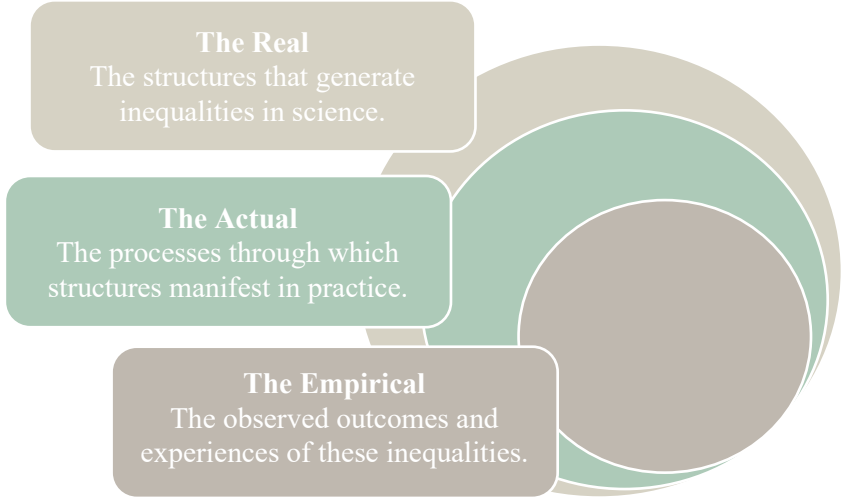


Figure 3. Conceptual layers of inequality in scientific collaboration, adapted from Bhaskar's (1975) critical realist ontology (own depiction).

3.2. Research Process

In the following, I outline the research process, the underlying reasoning, and its main stages. Figure 4 illustrates this process across macro, meso, and micro

levels of analysis, highlighting the analytical focus of each paper, however, presenting the process in a more organized manner than it unfolded in practice.

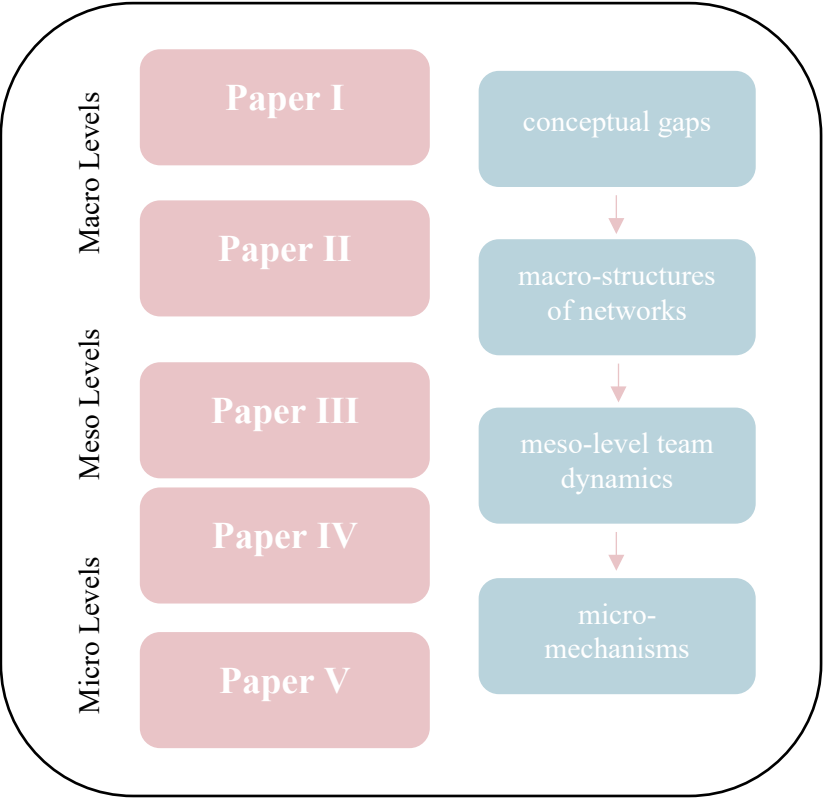


Figure 4. Overview of the research process across macro, meso, and micro levels, showing the analytical focus of each paper (own depiction).

Beginning the doctoral project on international research collaboration, inequality quickly emerged as a hotly debated topic. Delving into this topic, I found a large body of empirical studies providing case-based evidence of inequality. However, this literature was highly scattered and rarely grounded in theoretical frameworks, with a few exceptions such as Walsh et al. (2016). On the other hand, I found meta-level theories such as postcolonial theory (Harding, 2009) and world-systems theory (Schott, 1998), which offered powerful but abstract explanations that seldom connected with empirical realities. Only a few studies, for instance, Bauder (2015) and Demeter (2019), effectively bridged these two levels.

In the initial phase of the project, I conducted a literature search and exploratory interviews regarding colleagues' experiences in North–South collaborations. This process helped me gain familiarity with both existing research and the lived experiences surrounding international research collaboration. Through this process, several important themes emerged—such as mobility, networks, funding, and the role of personal ties—which were evident in both theoretical and empirical accounts. These themes continued to evolve throughout the project and guided its overall development.

In the middle phase of the project, I aimed to link the—in my view, rather scattered—literature on inequality with a concept widely applied in research collaboration studies: proximity. I found that there was very little overlap between the two, but recognized that the idea of proximity could be enriched by explicitly accounting for inequality in global science. This resulted in a critical narrative literature review, which culminated in a conceptual book chapter (Ralfs, 2024).

Parallel to this conceptual work, I began the empirical work with co-authors planning and designing studies, applying for ethical approval, and beginning to analyze scientometric data.

We designed a survey to bridge large-scale quantitative analyses of collaboration and citation networks with researchers' lived experiences and perceptions. Conducted between June and November 2023, the survey gathered information on various aspects of scientific collaboration, including motivations to collaborate, perceptions of labor division and agreement, factors shaping the research question, and respondents' mobility histories. In analyzing the data, we focused on different dimensions of agreement between collaborators: the extent to which their perceptions aligned, how they rated agreement on specific aspects of the collaboration, and how they assessed the importance of different factors in shaping the research question. By placing special emphasis on the process of research agenda setting, we aimed to distinguish structural pressures (e.g., publishing demands) from agency-based and relational aspects (e.g., personal and collaborators' interest in the topic).

Around the same time, we began working with Contributor Role Taxonomy (CRediT) contributorship data, which detail individual tasks reported for publications involving high-, middle-, and low-income countries, provided by the Public Library of Science. In this context, the notion of building and exchanging scientific capital (Bozeman & Corley, 2004) proved particularly useful for understanding the division of labor in international collaboration. As the work progressed, we developed a specific focus on researcher mobility,

emphasizing both the structural concentration of scientific capital in high-income regions and the agency of individual researchers in navigating or circumventing these inequalities. In doing so, the study also revealed important policy dimensions, illustrating how mobility operates at the intersection of individual agency and structural constraints.

Both quantitative studies, resulting in Papers III and IV, focused on team dynamics in international collaboration. They provided insights into overall structures (such as funding concentration), while also capturing researchers' perceptions and lived experiences (for example, agreement within teams and factors influencing research questions).

After attending the Advanced School on Innovation and Science Diplomacy at the University of São Paulo in mid-2023, and through ongoing discussions on North–South dynamics, my co-authors and I began developing a study on the geographical mapping and network structure of science diplomacy scholarship. The study further strengthened the policy dimension of my work, demonstrating how policy shapes both structure (the concentration of networks in HICs) and agency (the actions countries and individual actors take to engage with those networks). This work was published in *Scientometrics* in August 2025 (Rüland et al., 2025).

In spring 2024, together with my co-author, I developed the research plan for a qualitative case study on Swedish–Bolivian research capacity building cooperation, conducted between May and August 2024. This in-depth study provided detailed insights into a long-term collaborative arrangement between a sponsor, universities in a high-income country, and two in a lower-middle-income country. It highlighted the interplay of science policy and scientific practice, illuminating both structure (the institutional environments in which these universities operate) and agency (how actors position themselves within the realm of international collaboration).

The parallel collection and analysis of data across the four empirical studies allowed them to inform one another, enabling the exploration of shared themes like agenda-setting from multiple angles using diverse data sources. I engaged in multiple rounds of analysis and feedback on each article with my co-authors, and we presented the work at academic conferences.

Through iterative development—anchored around milestones such as the research proposal seminar, mid-seminar, and final seminar—writing the kappa became a process of synthesis. Drawing on the collected material, I aimed to connect macro-level theoretical explanations of persistent inequality with micro- and meso-level concepts commonly applied to international

collaboration. This synthesis made it possible to highlight the agency of individual actors navigating unequal structures. Writing the kappa in parallel with the articles helped articulate an overarching theoretical framework and the integration of findings from the four empirical studies into a coherent whole.

3.3. Overview of Papers

Table 1 provides an overview of the five papers that form the foundation of this compilation thesis, including their titles, authors, and main methodological approaches. The table also indicates which of the overarching research questions of this thesis each paper addresses. Summaries of the key findings of each paper are presented in Section 4.

Table 1. Overview of papers, authors, methodological approaches, and addressed research questions

Paper	Title	Author(s)	Method	RQ
Paper I (Book Chapter)	Proximity and Inequality in Academia	Annika Ralfs	Critical Narrative Review	RQ1
Paper II (Article)	Science Diplomacy: A Global Research Field? Findings from a Bibliometric Analysis of the Science Diplomacy Scholarship of the Past Twenty Years	Anna-Lena Rüländ, Lise H. Andersen, Alan Kai Hassen, Carrington Kinyanjui, Annika Ralfs, Bruno Iochins Grisci	Bibliometric and Network Analysis	RQ2
Paper III (Article)	Bridging the Divide? Labor Division and Researcher Mobility in International Scientific Collaborations	Annika Ralfs, Vinicius Muraro, Alysson Mazoni, Pauline Mattsson	Scientometric Data Analysis	RQ1, RQ2
Paper IV (Article)	Reconciling Perspectives? Perceived Agreement in International Teams	Annika Ralfs, Pauline Mattsson	Survey Analysis	RQ1
Paper V (Article)	Developmental Universities in Bolivia: Navigating International Collaboration and Research Capacity Building	Annika Ralfs, Carlos Acevedo	Qualitative Case Study	RQ1, RQ2

3.4. The Case for a Multi-Method Research Design

Much of the research on inequalities in scientific collaborations among high-, middle-, and low-income countries remains fragmented. Most studies focus on isolated empirical phenomena and maintain a strict divide between quantitative and qualitative approaches, with few utilizing conceptual frameworks.

A substantial body of quantitative research has mapped structural inequalities in science through co-publication and citation network analyses (Boshoff, 2010; Chinchilla-Rodríguez et al., 2019; Confraria et al., 2017; Czaika & Orazbayev, 2018; Gonzalez-Brambila et al., 2013; Pradier et al., 2024; Ynalvez & Shrum, 2011). These studies consistently reveal core-periphery dynamics and global patterns of scientific dominance, providing large-scale, systematic insights. However, they often fail to capture the internal, team-level dynamics of collaboration—specifically, how tasks, responsibilities, and decision-making are distributed in practice.

Qualitative research offers a complementary perspective, providing detailed accounts of how inequalities manifest within collaborative teams (Asare et al., 2020; Bradley, 2008; Gunasekara, 2020; Koch et al., 2025; Kontinen & Nguyahambi, 2020; Matenga et al., 2019; Munung et al., 2017). Through interviews, ethnographic observation, and case studies, such research highlights how power imbalances and practices of equity, or extraction, unfold within specific projects or partnerships. While these studies provide valuable insights into lived experiences, they often have limited generalizability and tend to focus on either exemplary best practices or highly problematic cases.

To bridge the gap between macro-patterns and individual cases—mirroring the theoretical link between structure and agency—this thesis adopts a multi-method design (Creswell & Plano Clark, 2018), integrating conceptual, quantitative, and qualitative approaches. While each empirical paper uses either a conceptual, quantitative or qualitative design, together they provide complementary perspectives. The quantitative analyses map large-scale structural inequalities and meso-level team dynamics, whereas the qualitative study captures micro-level agency within a long-term institutional cooperation between Sweden and Bolivia.

Each level of analysis carries distinct strengths and limitations. Macro-level studies reveal overarching trends but rarely uncover the mechanisms that sustain them. Micro-level case studies expose practices and long-term dynamics but are, by definition, context specific. Meso-level analyses, which focus on mechanisms and measurable dynamics within collaborations, risk

overlooking connections to both macro structures and micro practices. Integrating these approaches allows the thesis to identify the mechanisms connecting different analytical levels, revealing both the enduring structures and evolving dynamics that shape international scientific collaboration.

Additionally, the studies offer conceptual reflections that situate the empirical findings within broader debates on inequality and collaboration in global science. Building on this rationale, the thesis employs an abductive research approach (Timmermans & Tavory, 2012), moving iteratively between empirical observation and theoretical reasoning. Integrating these approaches at the thesis level enables triangulation—connecting macro-level structures with situated research practices—and provides a more layered and comprehensive understanding of team-level collaboration within an unequal scientific system.

3.5. Data Sources

The data collected for this study draw on a variety of sources. Integrating these sources allows for a more comprehensive understanding of the mechanisms through which collaboration both reflects and responds to inequality. Building on this broad empirical foundation, the thesis provides a layered response to the central research questions—examining how inequality is reflected in, and addressed through, international research collaboration.

The narrative literature review (Paper I) builds on systematic literature searches aimed at examining the intersection between research on proximity—a concept widely applied in studies of research collaboration (Frenken et al., 2009)—and the more fragmented literature addressing inequality in international science. Relevant articles were identified through keyword searches related to proximity, inequality, and various geographical markers in Google Scholar and Scopus. The review focused on studies situated at the intersection of proximity and inequality in collaboration. Articles were selected for their relevance to the guiding question: How can the concept of proximity be expanded by incorporating notions of inequality in scientific capital among high-, middle-, and low-income countries to gain a more comprehensive understanding of international research collaboration?

For the geographical mapping of science diplomacy scholarship (Paper II), relevant articles were bulk-extracted from Scopus using predefined keyword searches and subsequently filtered according to inclusion criteria established

by field experts. The bibliometric metadata included information such as authors' affiliations and funding sources. To qualify for inclusion, articles had to address science diplomacy and contain geographical markers in their abstracts. These markers were extracted in a first step using OpenAI's GPT-4 and then verified manually for relevance and accuracy. The final dataset comprised 250 publications.

The data underlying Paper III draw on scientometric information, including contributorship data that record the allocation of individual research tasks (Larivière et al., 2021) according to the CRediT taxonomy, provided by the Public Library of Science (PLOS). The dataset was filtered to include collaborations involving two to twenty coauthors with representation from both high- and low- or lower-middle-income countries. Additional bibliometric data at the paper and author levels were obtained from Scopus and OpenAlex, including variables such as academic age and past international mobility inferred from affiliation histories across income groups. The final dataset comprised 37,329 authors and 4,942 articles from PLoS journals focused on life sciences and medical research. For additional robustness checks, a sub-sample was created, restricted to articles with the last author affiliated with a low- or lower-middle-income country, as well as collaborations among high- and upper-middle-income countries.

Paper IV draws on data from a personalized survey of 1,540 researchers, capturing their experiences working on collaborative projects that resulted in co-authored publications. The survey covered 1,123 articles in the life sciences and medicine from journals such as the *British Medical Journal* and *BioMed Central*, focusing on author teams of two to five researchers. For many publications, responses were obtained from multiple authors, enabling triangulation and comparison of perspectives on the collaborative processes underlying each project. Additionally, bibliometric metadata for these articles were obtained from Scopus.

The data for Paper V consist of qualitative material, including sixteen semi-structured interviews with Swedish and Bolivian researchers and policymakers as well as policy documents and strategy reports from the Bolivian and Swedish national governments, the Swedish International Development Cooperation Agency (Sida), and two public Bolivian universities. In addition, I conducted ethnographic observations during a two-month research stay at Universidad Mayor de San Simón in Cochabamba, with supplementary visits to research centers at Universidad Mayor de San Andrés in La Paz.

Taken together, these diverse data sources provide a multifaceted foundation for the analysis. Combining bibliometric, survey, and qualitative data allows for a deeper understanding of how inequalities in collaboration are structured, perceived, and negotiated across different levels. The studies cover a broad range of scientific fields: Papers I and II focus primarily on the social sciences and humanities, Papers III and IV address life sciences and medical research, and Paper V centers on technological areas. The data also illuminate different levels of collaboration, from the macro-level view of scholarly networks (Paper II) to team-level dynamics such as the division of labor (Paper III), to researchers' lived experiences captured in surveys (Paper IV), and interviews (Paper V). While each data source has its limitations, their complementarity strengthens the overall analysis, providing both breadth and depth.

3.6. Analyses

The thesis integrates studies employing distinct methodologies—conceptual, quantitative, and qualitative—and combines them into the multi-method design of the thesis as a whole.

The critical narrative review (Paper I) was based on a targeted literature search and a critical synthesis of findings. Unlike a systematic literature review, this approach was guided by a specific research question: to what extent does the literature on proximity in scientific collaboration account for inequality? The review revealed minimal overlap between the two bodies of work. However, I argue that across each of the five dimensions of proximity identified by Boschma (2005)—geographical, cognitive, social, organizational, and institutional—scientific inequality between countries significantly influences both the likelihood and the ease of collaboration.

Paper II employs a LLM-enhanced bibliometric and network analysis based on the sample of 250 publications on science diplomacy. Geographical markers, author affiliations, and funding data were standardized and aggregated using the UN Geoscheme. The dataset was analyzed using descriptive statistics and network analysis, including visualizations and centrality measures across four time periods (2002–2008, 2009–2012, 2013–2019, 2020–2023) to identify trends, collaboration patterns, and the prominence of specific countries and regions in the literature. The science diplomacy scholarship was mapped along three dimensions: (i) the geographical distribution of authors and their collaborative networks, including their centrality; (ii) the geographical

distribution of reported funding sponsors in the articles; and (iii) the regional focus of the studies, identifying which countries and regions have been most frequently examined.

Paper III is based on a dataset of CRediT contributions provided by the Public Library of Science (PLOS) for the period 2018–2023, combined with paper- and author-level metadata from OpenAlex. The study focuses on five main tasks: conceptualization, resources, investigation, formal analysis, and writing the original draft. First, within-task division of labor is analyzed to examine the extent to which authors from high-, low-, and lower-middle-income countries contribute to the same task within a paper, using descriptive statistics to identify patterns of task sharing. Second, between-task labor division is analyzed to determine which researchers are most likely to perform particular tasks. Using logistic regression, we consider characteristics such as seniority, gender, author position, and country affiliation, with special attention to mobile researchers—those who have previously changed affiliation between income groups or currently hold affiliations in both HICs and LMICs. Several robustness checks are performed to validate the findings.

Paper IV draws on the survey data from 1,540 responses regarding collaborative research projects, supplemented with bibliometric metadata from Scopus. The analysis employs different statistical calculations, including linear mixed models, regression analysis, and propensity score matching. Agreement between researchers based in HICs and LMICs is measured in various ways: a direct score of agreement on different aspects of the collaboration assigned by respondents; the degree to which respondents share similar perceptions of the collaboration; and the extent to which they prioritize the same factors relating to the research question.

Paper V is based on the qualitative analysis of interviews, policy documents, and ethnographic observations collected during a research stay. The empirical material was stored and organized in NVivo, coded, and analyzed through ongoing dialogue among the co-authors. Five key strategic dimensions emerged for developmental universities seeking to build capacity in the realm of international cooperation: research governance, infrastructure development, Ph.D. training, innovation programs, and collaboration with international partners. These themes were identified iteratively, reflecting an ongoing dialogue between theory and empirical evidence throughout the data collection and analysis process.

Employing these diverse methods has allowed for a multi-level examination of international research collaboration. The studies complement each other by

targeting different analytical units and scales. Paper I provided a conceptual lens, identifying key gaps in how inequality is considered within the literature on scientific collaboration. Papers II, III, and IV applied quantitative approaches to capture broader structures and dynamics in research fields—mapping science diplomacy (Paper II) and exploring team-level processes in life sciences and medicine (Papers III and IV). Paper V, through a qualitative analysis of a long-term case, provides detailed insights into the mechanisms and decision-making that shape collaboration over time. Together, these studies move beyond the traditional focus on outputs, such as publications, to illuminate the processes and interactions that underpin research collaboration.

3.7. Limitations

This thesis provides important insights into international research collaboration and inequality, but it is subject to limitations that shape the scope and interpretation of the findings. These limitations stem primarily from the data sources, methodological choices, and the specific case studies that underpin the analysis.

Much of the knowledge production examined here relies on existing bibliometric databases and published literature, which themselves reflect systemic asymmetries within the global scientific system. For instance, the dominance of English as the primary language of scientific publishing and the focus on journal articles mean that research published in other languages or in alternative formats is underrepresented. While efforts were made to employ more inclusive databases, such as OpenAlex (Priem et al., 2022), linguistic and publication biases continue to limit the inclusivity of the data, particularly marginalizing scholarship from lower-income regions and non-traditional publishing venues.

Moreover, Papers II, III, and IV focus—directly or indirectly—on publications, which themselves represent outcomes of successful collaborations resulting in co-authored outputs. This introduces a success bias, as the analyses primarily capture collaborations that reached the publication stage. Consequently, instances where structural barriers hindered the formation of international teams, or where collaborations dissolved before producing tangible outcomes, remain outside the scope of these studies. As a result, the findings may over-represent effective or functional collaboration patterns while under-representing failed or unrealized partnerships. Additionally,

collaboration in the quantitative studies is conceptualized very narrowly as co-authorship, whereas collaboration more broadly encompasses a range of activities, from informal advice and networking to participation in scientific communities.

Finally, the in-depth case study of Swedish–Bolivian research capacity building (Paper V), while rich in detail and insights, may not be representative of capacity-building efforts generally. Different donor countries employ varied approaches, and Sweden’s long-term institutional support model is relatively unique (Nilsson & Sörlin, 2017), limiting the generalizability of this case.

Thus, overall, the thesis may be biased toward successful cases of collaboration—an aspect that should be acknowledged when interpreting the findings. Nevertheless, its multi-method approach, which balances the strengths and limitations of the individual studies, offers valuable insights into the underexplored dynamics of inequality and collaboration in international research.

3.8. Reflexive Statement

This work has been informed by my research stays, courses, and conferences across several Latin American countries, as well as conversations with interviewees, colleagues, and peers engaged in scientific practice around the world. However, my formal education and scientific work experience have been largely situated in Europe, specifically Sweden. Consequently, I acknowledge that the insight I bring to this research is shaped by the vantage point of high-income countries, and I cannot speak from the lived experiences of those outside these contexts.

This thesis is not only about international research collaboration but is also, in many ways, a product of it. Working alongside co-authors from different countries and disciplines has provided firsthand insight into the dynamics and complexities of the research system. Throughout this process, I encountered tensions between the incentive structures governing my work as a Ph.D. candidate—pressures emphasizing career advancement—and the practices I deem worthwhile. At the same time, actively engaging in international collaboration revealed opportunities to challenge and modify conventional modes of doing science, even if only incrementally. On a personal level, navigating the challenges of cross-border and interdisciplinary collaboration has been enriching. These experiences have shaped my understanding of the research process and informed my approach to this thesis.

4. Findings

4.1. Paper I: Proximity and Inequality in Academia

Annika Ralfs

Paper I examines the intersection of the literature on proximity in its various dimensions and research on inequality in science. I find very little overlap between these two literatures. However, I argue that considering the inequality of scientific capital provides a more comprehensive understanding of why researchers collaborate than proximity alone.

The proximity literature rarely addresses inequality and is largely limited to the experiences of researchers in higher-income countries. This book chapter expands the concept of proximity by incorporating insights from research on inequality in global academia. I argue that inequality shapes each of the five commonly recognized dimensions of proximity, often presenting both risks and opportunities, and constituting either benefits or obstacles for collaborations between researchers from high-, middle-, and low-income countries. All dimensions of proximity are dynamic, albeit to varying degrees, and often asymmetrical.

- i. The lack of geographical proximity can pose a fundamental obstacle to encounters and collaboration between researchers in core and peripheral regions. While mobility can partially mitigate this barrier, opportunities are distributed unevenly.
- ii. Cognitive proximity refers to the overlap in knowledge bases between researchers. Collaboration can increase cognitive proximity; however, if knowledge exchange is not reciprocal, it may result in unidirectional flows from the core to the periphery.
- iii. Social proximity develops as trust-based relationships form. Limited opportunities for initial interaction can hinder network entry for researchers in peripheral locations. Once established, social proximity has been shown to bridge large geographical distances.

- iv. Organizational proximity may impede collaboration when researchers are distant from core institutions, as differences in organizational environments, policies, and power asymmetries create obstacles for researchers collaborating across high-, middle-, and low-income countries.
- v. Institutional proximity refers to the alignment of incentives and broader regulatory or policy frameworks. While international policies may promote collaboration and mobility, they frequently exclude researchers in peripheral regions, reinforcing asymmetries in opportunities.

In sum, the concept of proximity can be meaningfully expanded by emphasizing inequality and asymmetry when analyzing international research collaboration. While proximity — or its absence — can facilitate or hinder collaboration, the unequal distribution of academic capital frequently plays a crucial role in motivating researchers to collaborate.

4.2. Paper II: Science Diplomacy: A Global Research Field? Findings from a Bibliometric Analysis of the Science Diplomacy Scholarship of the Past Twenty Years

Anna-Lena Rüland, Lise H. Andersen, Alan Kai Hassen, Carrington Kinyanjui, Annika Ralfs, Bruno Iochins Grisci

In Paper II, we set out to geographically map science diplomacy scholarship, a distinctive research field shaped by both scholars and practitioners. We analyzed trends and dynamics over the past two decades across three dimensions: (1) the geographical distribution of authors and collaborative networks, (2) the geographical distribution of funding sources, and (3) the geographical regions examined in science diplomacy publications.

Overall, we find that authorship and thematic focus in science diplomacy remain more nationally oriented than might be expected for a field closely intertwined with international politics and commonly framed as addressing global challenges.

- i. Authorship, which initially emerged from the United States, remains heavily concentrated in North America and Europe. Contributions

from Asia and Latin America have increased only recently, while Africa and Oceania feature very little. This concentration is mirrored in collaborative networks, where North American and European countries occupy central positions, and diversification occurs only gradually.

- ii. Regarding funding, European countries and the European Union stand out as the primary sponsors of research on science diplomacy, although there has been a recent surge in Asian funding sources.
- iii. The regional focus of studies—that is, the countries and regions examined in science diplomacy publications—follows a similar pattern to authorship. It remains highly national in outlook but shows slightly faster diversification over the years.

We conclude that science diplomacy scholarship reflects typical North-South dynamics of an emerging research field, with a strong core in Europe and North America. Other regions are connecting to this network only gradually, often through targeted investments or special publishing initiatives.

4.3. Paper III: Bridging the Divide? Labor Division and Researcher Mobility in International Scientific Collaborations

Annika Ralfs, Vinicius Muraro, Alysson Mazoni, Pauline Mattsson

In Paper III, we analyzed the division of labor in international research collaborations involving partners from high-income countries (HICs) and low- and middle-income countries (LMICs) to understand how the unequal global distribution of scientific capital translates into differentiated roles within collaborative research.

We examined the division of labor along two dimensions.

First, we analyzed the extent to which researchers with different income-group affiliations share labor, defined as contributing to the same task within the same article. Across contribution types, conceptualization emerged as the most frequently shared activity between HIC- and LMIC-affiliated authors. In contrast, the other tasks tended to be performed separately.

Second, we examined how labor is distributed across researchers, focusing on which groups are most likely to perform specific tasks. The findings confirm persistent global asymmetries in research collaboration: data collection tends to be concentrated in LMICs, while conceptualization, data analysis, and manuscript writing are more prevalent among researchers based in HICs.

Finally, we identified a distinct group of mobile researchers—those who have previously moved between HICs and LMICs or hold simultaneous affiliations in both contexts. These individuals play a special role in collaborative teams. Their contribution profiles closely resemble those of HIC-affiliated researchers, but they are even more likely than stationary HIC researchers to engage in conceptualization and manuscript writing.

Overall, these findings illuminate the types of scientific capital exchanged within international collaborations: on the one hand, access to cases and context-specific knowledge, and on the other, access to economic resources, research infrastructure, and publishing experience.

4.4. Paper IV: Reconciling Perspectives? Perceived Agreement in International Teams

Annika Ralfs & Pauline Mattsson

In Paper IV, we explored collaborative dynamics and researchers' perceptions, analyzing how HIC- and LMIC-based collaborators—embedded in different institutional contexts and shaped by distinct experiences—aligned their views when setting research agendas and defining the terms of collaboration within international teams.

To do so, we examined perceived agreement on various aspects based on survey responses, including agreement on project vision, contributions, budget, timelines, and communication, as well as perceptions of the importance of different factors shaping the research question.

Our findings reveal significant differences in perception between HIC- and LMIC-based authors, even when controlling for other characteristics:

- i. Agreement on project vision and contributions: While overall levels of agreement were high, LMIC-based researchers consistently reported lower perceived agreement with their co-authors—both HIC- and LMIC-based—than their HIC counterparts.

- ii. Agreement on budget, timelines, and communication: LMIC-based respondents also perceived lower levels of agreement on these aspects compared to HIC-based respondents, regardless of their co-authors' affiliation.
- iii. Factors shaping the research question: Across both groups, personal interest was identified as the most influential factor. However, LMIC-based respondents consistently rated external pressures—such as funder requirements, publication prospects in target journals, and data availability—as having a greater influence on the formulation of research questions compared to HIC-based researchers.

Taken together, these findings provide insight into the team-level dynamics of shaping research agendas in international collaborations. They highlight persistent perceptual differences between HIC- and LMIC-based authors but also suggest that lower perceived agreement among LMIC researchers may not stem solely from HIC–LMIC power asymmetries. Rather, it may also reflect internal hierarchies and stronger external pressures within research environments characterized by greater resource scarcity.

4.5. Paper V: Developmental Universities in Bolivia: Navigating International Collaboration and Research Capacity Building

Annika Ralfs & Carlos Acevedo

In Paper V, we conducted an in-depth case study of two public Bolivian universities—Universidad Mayor de San Andrés (UMSA) and Universidad Mayor de San Simón (UMSS)—to examine how they position themselves within international research collaboration, particularly in relation to research capacity-building initiatives funded by the Swedish International Development Cooperation Agency (Sida). The analysis was guided by the developmental university ideal, which emphasizes the democratization of knowledge to foster inclusive and sustainable development.

We explored how these universities navigate their engagement with international partners while striving to strengthen their scientific capacities in technologically advanced fields, all without compromising their institutional sovereignty or succumbing to academic dependency.

Our findings reveal five interrelated strategic dimensions in which developmental universities balance local and foreign interests in international collaboration:

- i. Research governance: Establishing research governance systems enables universities to define their own research lines and priorities, allocate resources strategically, and pursue agendas aligned with local and national needs.
- ii. Infrastructure: Adequate research infrastructure is a prerequisite for producing scientific outputs—especially in highly technological fields—and for enabling both local research and international collaboration.
- iii. Ph.D. education: Training researchers who are both internationally connected and locally grounded equips universities to conduct contextually relevant research that addresses challenges of inclusive and sustainable development.
- iv. Innovation programs: At the core of the developmental university model, innovation initiatives link academic research to specific societal problems. By engaging with non-academic stakeholders, universities can tailor research agendas to local challenges and promote social impact.
- v. International research collaboration: Developmental universities actively participate in global scientific networks. To strengthen equitable partnerships, recognizing mutual benefits is essential. Such collaboration contributes to the democratization of knowledge by allowing them both to draw on international expertise and to contribute marginalized perspectives to international science.

Across these five dimensions, we observe a marked evolution over the two decades of cooperation between the Bolivian universities, Sida, and Swedish universities. As scientific capacity has grown, partnerships have become increasingly interdependent, and research agendas have shifted toward addressing locally defined priorities.

5. Discussion

This thesis set out to examine (i) how practices within international scientific collaboration reflect and respond to structural inequalities, and (ii) the role of science policy in sustaining or mitigating these inequalities. It approaches international research collaboration as both a reflection of and a response to global scientific asymmetries across high-, middle-, and low-income countries. By integrating macro-level structural perspectives with agency-centered approaches, the thesis shows how collaboration is shaped by systemic disparities yet enacted through the situated and strategic choices of researchers. In doing so, it highlights the dual nature of collaboration—both as a product of unequal global conditions and as a potential arena for negotiating and transforming them.

The five papers offer complementary analytical levels and vantage points, collectively contributing to a more nuanced understanding of how inequalities are reproduced, negotiated, and, occasionally, reconfigured through scientific collaboration. The results and discussion that follow synthesize these findings, identify key patterns of collaboration and inequality, and draw out their theoretical and practical implications for global science policy.

The discussion proceeds in three parts. The first examines how collaborative practices both reflect and respond to structural inequalities—focusing on researchers’ motivations, barriers to collaborate, and team dynamics in the division of labor, setting research agendas, and building consensus. The second part turns to the role of science policy in shaping, perpetuating, or challenging inequalities through instruments such as science diplomacy, mobility schemes, and capacity-building initiatives, assessing their potential either to mitigate or to sustain asymmetries in global science. Finally, the concluding discussion synthesizes the main insights to draw broader implications for the interplay of structure and agency in global science.

5.1. Inequality Reflected in International Research Collaboration

This section addresses the first research question: how practices within international scientific collaboration reflect and respond to structural inequalities. Disparities pervade international research collaborations, shaping both the opportunities available to researchers and the constraints they encounter, influencing motivations and barriers to collaboration. These structural conditions interact with individual and collective agency within teams, affecting how collaborators divide labor, set research agendas, and reconcile differing perspectives. The interplay of these mechanisms is illustrated in Figure 5.

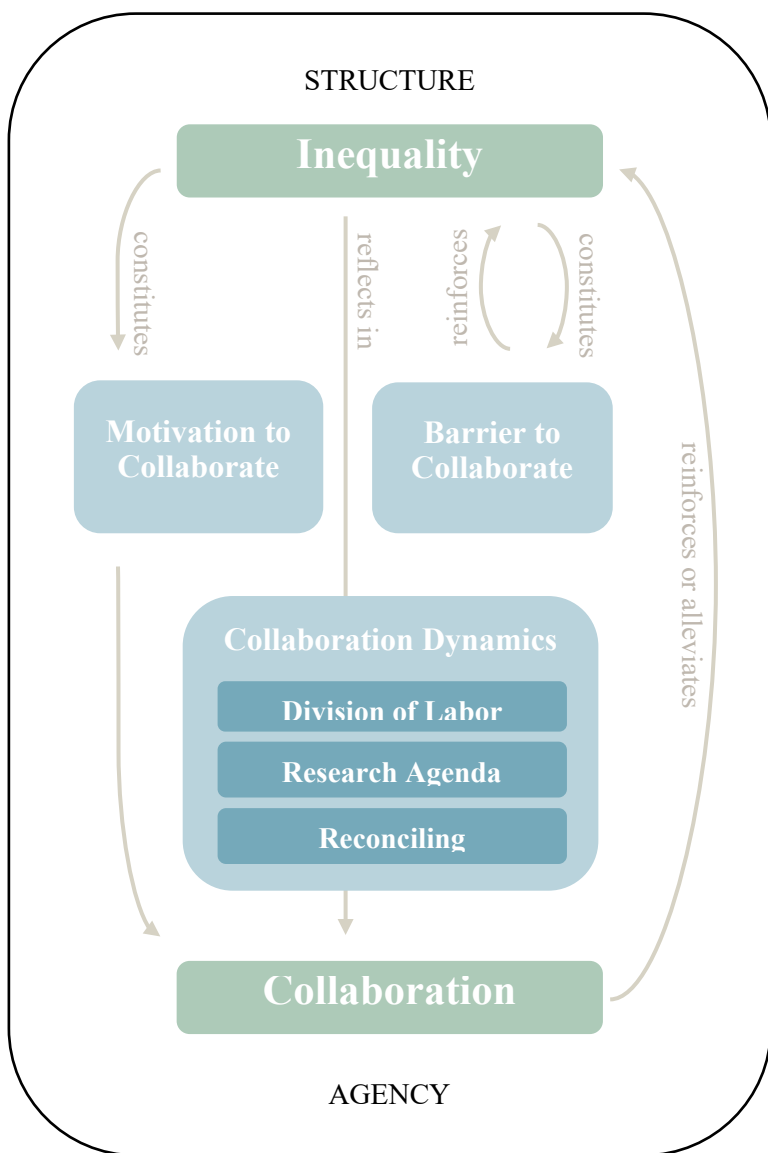


Figure 5. Inequality in international scientific collaboration: acting as a motivation, a barrier, and shaping collaborative practices (own depiction).

5.1.1. Inequality as a Motivation for International Collaboration

World-systems theory highlights the structural disparities between the core and periphery in global science (Demeter, 2019; Hwang, 2008; Schott, 1998; Zelnio, 2012), illustrating the persistence of inequality in the global science system. While world-systems theory highlights structural hierarchies, it pays less attention to the relational and transactional dimensions of collaboration.

It is often claimed that international research collaborations benefit from the pooling and exchange of knowledge and resources across diverse contexts (e.g., Ubfal & Maffioli, 2011; Wagner et al., 2001). However, comparatively fewer studies (Dusdal & Powell, 2021; Koch et al., 2025; Munung et al., 2017) have explicitly examined the concrete mechanisms through which such exchanges take place. In this context, the concept of *scientific capital* (Bourdieu, 1986; Bozeman & Corley, 2004; Demeter, 2019; Walsh et al., 2016) provides a useful lens for understanding how material, embodied, and symbolic resources circulate between actors in asymmetrical collaborations between the global core and periphery. Building on this framework, Paper I analyzes how these different forms of capital manifest in practice within an asymmetrical international science system, drawing on Bozeman and Boardman's (2014) distinction between material, embodied, and symbolic capital.

Material capital—such as research funding and infrastructure—is a key source of global asymmetries, thus providing incentives for collaboration (Muriithi et al., 2018). The case study presented in Paper V illustrates the dilemma faced by many researchers and universities in lower-income countries vividly. In Bolivia, limited government investment and weak private-sector engagement in research leave universities with few options but to seek international partners. Consequently, during the early phases of the Bolivia–Sweden cooperation, most Bolivian Ph.D. training took place at Swedish universities due to a lack of specialized equipment for advanced material analysis in Bolivia. Although well-equipped research centers have since been established in prioritized areas at Bolivian universities, their sustainability still depends on foreign investment. The maintenance of specialized infrastructure still requires importing spare parts and flying in technical staff, while national government funding remains limited.

A similar picture emerges with *embodied capital*, referring to technical skills and research experience. At the beginning of the collaboration in the early 2000s, there were few Ph.D.-qualified supervisors in Bolivia, so Swedish supervisors primarily guided the Ph.D. training. Over time, however, the

partnership became more balanced through capacity building, experience, and trust (Paper V). This evolving dynamic is also reflected in Paper III, which shows that researchers affiliated with HICs are more likely to engage in writing and analytical tasks, whereas those based in LMICs more frequently contribute to data collection and experimental work. We interpret this complementarity of scientific capital as a key motivation for collaboration: researchers seek to combine and leverage their access to different forms of capital. For instance, the greater involvement of HIC-based researchers in data analysis reflects their access to computational infrastructure and large-scale databases (Munung et al., 2017; Okeke, 2016; Wagner et al., 2001), while LMIC-based researchers contribute essential local expertise and contextual understanding of research problems, particularly in fields such as public and global health (Bardosh, 2018; Matenga et al., 2021).

Symbolic capital, including scientific reputation and credibility, further reinforces global asymmetries in visibility and recognition. Researchers affiliated with institutions in HICs often occupy more writing positions (Paper III), which reinforces their authority and global visibility. In contrast, LMIC-based researchers often contribute crucial empirical work but remain less visible in the symbolic economy of publications and citations. Over time, however, sustained collaboration and capacity building—such as those in the Bolivia–Sweden case—can help local actors accumulate symbolic capital by co-developing and co-authoring publications, supervising new cohorts of researchers, and securing independent recognition within international research networks (Paper V).

Accordingly, examining the micro-level dynamics of scientific collaboration and international research teams reveals how the concept of *scientific capital* can shed light on individual responses to structural inequality. In seeking to build their own scientific capital (Bozeman & Corley, 2004), researchers may strategically seek partners with complementary forms of capital. Within such collaborations, these capitals are exchanged and jointly developed; however, this process also carries the risk of reinforcing existing asymmetries, further concentrating capital within the scientific core. Taken together, these dynamics illustrate how structural inequalities within the core–periphery hierarchy of global science motivate collaboration. Such partnerships allow researchers to access complementary resources, infrastructures, and expertise—assets that remain unevenly distributed across high-, middle-, and low-income countries.

5.1.2. Inequality as a Barrier to International Collaboration

The asymmetries described by world systems theory (Demeter, 2019; Hwang, 2008; Schott, 1998; Zelnio, 2012) illustrate the persistent hierarchies within the global science system and represent structural barriers to international collaboration (Matthews et al., 2020; Muriithi et al., 2018). While such asymmetries can create incentives and motivations for researchers to collaborate, they also constrain who can participate, under what conditions, and with what degree of influence.

To illustrate how these structural barriers manifest in practice, I draw on the proximity literature (Boschma, 2005; Hoekman et al., 2010). Researchers and their collaborations are shaped, to varying degrees, by their proximity across multiple dimensions, such as cognitive, institutional, organizational, social, and geographical. In Paper I, I explore how these multifaceted dimensions of proximity interact with the persistent inequalities embedded in the global scientific system (Ralfs, 2024). Structural inequalities translate into proximity dynamics that shape both access to and engagement within scientific networks, serving either as enablers—facilitating collaboration where connections are easier to establish—or as barriers, where differences or distances along these dimensions inhibit opportunities for meaningful engagement. However, a certain degree of distance can also be beneficial; often, an optimal balance exists between being too proximate—which can limit the inflow of new ideas—and being too distant, which increases transaction costs and hinders mutual understanding (Balland et al., 2015; Boschma, 2005).

Concerning *cognitive proximity*, both too little and too much can influence collaboration outcomes. A certain degree of cognitive distance—differences in knowledge bases—creates productive opportunities for learning, as collaborators contribute diverse yet complementary perspectives. However, such learning depends on the presence of bi-directional knowledge flows within collaborative networks (Díaz-Faes et al., 2023; Orazbayev, 2017; Syed et al., 2012). For instance, in the case of Swedish research capacity building with universities in Bolivia, knowledge exchange was not strictly unidirectional. While Bolivian researchers received training in highly technological fields, Swedish researchers also gained insights from new empirical contexts and from conducting research under conditions of relative scarcity (Paper V).

Similarly, in Paper II, the gradual inclusion of initially marginalized countries in the science diplomacy scholarship creates opportunities to introduce new perspectives, goals, and research topics (Echeverría-King et al., 2023; Shrestha

et al., 2022). Thus, while a complete lack of overlap between knowledge bases may impede collaboration, diversity and complementarity of cognitive perspectives can stimulate learning and foster the generation of new ideas within international teams (Hautala, 2011). Integrating perspectives rooted in the experiences of marginalized regions contributes to building more plural and inclusive international networks—provided these perspectives are incorporated on equitable terms. Achieving this requires openness to collaborators’ ideas and transparent communication about interests, expectations, and goals within research teams (Matenga et al., 2021).

The lack of *institutional* or *organizational proximity* between researchers in high-, middle-, and low-income countries can pose challenges, often making such collaborations more demanding than national ones (Matthews et al., 2020; Wagner et al., 2001). These challenges may involve logistical difficulties such as differing time zones and academic calendars, as well as disparities in institutional settings and incentive structures (Dusdal & Powell, 2021; Kontinen & Nguyahambi, 2020). This pattern is evident in the survey study (Paper IV), which examined how researchers evaluate factors relevant to the formulation of a research question. LMIC-based authors rated external factors—such as funder requirements, prospects for publishing in specific journals, and data availability—as significantly more important than their HIC-based counterparts did. This suggests that researchers in peripheral regions may experience stronger external pressures shaped by conditions of scarcity or a lack of proximity from publishers in the core (Collyer, 2018; Sutz, 2003). An example from Paper V illustrates the tension that Bolivian researchers experienced between the demands of international science—such as publishing in academic journals and attending international conferences—and their desire to contribute to solving urgent local problems in Bolivia.

Social proximity incorporates trust and friendly relationships (Agrawal et al., 2008; Nilsson, 2019). Its absence often reflects missing network ties between researchers, which in turn reduces the likelihood of collaboration. This is evident in the network analysis of science diplomacy scholarship (Paper II). The network initially formed around the U.S. and European countries, with other regions joining the network only gradually. Even recently, European and North American countries continued to show high centrality in collaboration networks, demonstrating the concentration of science diplomacy communities in the core of the science system, with connections to the periphery only slowly emerging. In these cases, the lack of collaborative ties between researchers in the core and periphery may constitute barriers to entry into scientific networks, and in a practitioner-driven, policy-relevant field such as science diplomacy,

they may have further implications on political inclusion. Instead, a more geographically diverse science diplomacy scholarship—one that fosters network ties and exchanges that bridge distances and differences—would hold greater potential for genuinely negotiating the goals and directions of scientific progress.

The case of Swedish-Bolivian research cooperation (Paper V) further demonstrates the crucial role of pre-existing network ties in initiating collaboration, with its roots traceable to individual actors who negotiated the cooperation in the 1990s. Since then, a robust network linking research groups across the involved universities developed, often enduring well beyond the initial formal agreements. Social proximity—in the form of friendly relationships and stable, long-term networks—emerged as a key theme in the Swedish-Bolivian cooperation. Many research teams extended their collaboration beyond the initial supervisor–supervisee relationships, working together across cohorts and building enduring partnerships grounded in mutual trust. This established familiarity with one another’s capacities enabled sustained collaboration across geographic distances and fostered increasing independence on the Bolivian side.

The lack of *geographical proximity* between countries in the core and periphery of the science system may seem immutable. However, even geographical proximity is not entirely static. This is exemplified by the prevalence of researcher mobility, discussed further in Section 5.2.2. Additionally, social proximity can partially substitute for a lack of geographical proximity (Agrawal et al., 2008; Hansen, 2015). Once personal ties are established—and with the support of modern communication technologies (Werker & Ooms, 2020)—collaboration based on trust and shared experience can span large distances.

Overall, these findings highlight that structural inequalities present significant barriers to forming collaborations between researchers in the core and periphery of the science system or to doing so on equitable terms. Moreover, the lack of cognitive, institutional, or social proximity can pose additional challenges for the establishment and sustainability of collaborations. Nevertheless, proximity in all its dimensions is not static. As researchers engage in joint projects, they continuously build and reshape proximity. This suggests that researchers can strategically build and leverage proximity to establish and strengthen ties. However, this process carries the risk of reinforcing asymmetries if proximity primarily favors the core—through unidirectional knowledge flows or adaptation to core institutional norms—rather than building common ground.

5.1.3. Inequality Reflected in Collaboration Dynamics

Postcolonial theory highlights how science continues to reproduce colonial legacies between researchers in the Global North and South (Ergin & Alkan, 2019; Harding, 2009; Mignolo, 2011). Structural disparities among high-, middle-, and low-income countries not only create unequal preconditions for collaboration but also shape the collaborative process itself. Persistent structural inequalities often manifest in imbalanced divisions of labor within teams (Chersich et al., 2016; Chinchilla-Rodríguez et al., 2019; Gunasekara, 2020; Mbaye et al., 2019; Smith et al., 2014), unequal influence over research agendas (Bhakuni & Abimbola, 2021; Bradley, 2008; Sridhar, 2012), and difficulties in reconciling perspectives within international teams (Adams et al., 2022; Dusdal & Powell, 2021; Kontinen & Nguyahambi, 2020; Matthews et al., 2020; Mweemba et al., 2019). All of these factors are crucial for understanding which challenges science addresses and whose concerns it prioritizes (Arocena & Sutz, 2021; Escobar, 1995; Fricker, 2007).

While postcolonial theory is crucial in explaining why inequalities in science are deeply rooted and enduring, it often emphasizes structural continuities and historical legacies, treating global hierarchies as relatively stable. As a result, it pays limited attention to the entry and withdrawal of actors, the evolution of scientific relationships, and the pragmatic strategies of individual researchers within these structures (Melin, 2000; Bauder, 2015). This contrasts with more agency-oriented perspectives, which emphasize temporality and change in social action (Emirbayer & Mische, 1998; Fraser, 1991; Powell & Colyvas, 2008). The following subsection explores how researchers in international teams spanning high-, middle-, and low-income countries respond to these entrenched inequalities.

5.1.3.1. *Division of Labor*

The global academic system reproduces a hierarchical division of labor in which theoretical and conceptual contributions are largely attributed to the Global North, whereas the Global South is relegated to supplying empirical case studies (Ergin & Alkan, 2019; Martín, 2017). To understand how structural inequality reflects in the situated dynamics of international research teams, including the division of labor, the concept of *scientific capital* is helpful (Koch et al., 2025; Walsh et al., 2016). Structural inequalities shape the types of capital to which researchers in different regions have access.

This also manifests in how labor is divided within research teams, as shown in Paper III. In health and life sciences collaborations, researchers based in HICs

are more frequently responsible for data analysis and publication writing, whereas those from LMICs primarily handle data collection. This pattern reflects the types of scientific capital exchanged in such partnerships—access to unique data and under-researched cases on one side, and access to advanced analytical facilities and publishing experience on the other (Mbaye et al., 2019; Munung et al., 2017; Okeke, 2016).

A similar division between data collection in LMICs and data processing in HICs was also visible during the early phases of the Bolivian Swedish research collaboration (Paper V). At that time, Bolivian Ph.D. candidates primarily conducted data collection at their home institutions, which lacked sufficient infrastructure and Ph.D.-educated supervisors. Samples—such as quinoa, tropical fruits, or bacteria—were then transported to Sweden, where Swedish supervisors provided training and supported the analyses.

As shown in the Bolivian–Swedish case (Paper V), this very typical division of labor in HIC-LMIC collaborations is often rooted in structural conditions, such as limited research infrastructure and technical expertise at universities in lower-income countries. Access to scientific capital—such as infrastructure, resources, and training—is often a prerequisite for researchers to undertake tasks such as advanced data analysis and academic publishing. However, the Bolivian–Swedish case also illustrates that these dynamics can evolve over time. As technological capacities at Bolivian universities expanded and collaborations deepened, the division of roles became less pronounced, with Bolivian researchers increasingly taking on conceptual tasks and conducting analyses independently.

While this division of labor is often shaped by underlying structural conditions, it is often also perceived differently by collaborators. Findings from Paper IV indicate that researchers based in HICs report significantly higher levels of agreement with both HIC- and LMIC-based colleagues regarding how tasks are distributed within teams. In contrast, researchers affiliated with LMICs report lower levels of agreement on contributions—even when collaborating with peers from the same or other LMICs. This asymmetry suggests that structural inequalities in global science shape not only the division of labor itself but also researchers’ perceptions and evaluations of collaborative dynamics (Matthews et al., 2020; Moyi Okwaro & Geissler, 2015; Munung et al., 2017; Smith et al., 2020).

Moreover, Paper III shows that the divide between data collection and data processing persists even when LMIC-based researchers occupy leading authorship positions in international teams. This indicates that while

gatekeeping by HIC-based researchers certainly exists, the unequal division of labor is deeply embedded in broader structural disparities within the global research system (Abimbola, 2019; Chersich et al., 2016; Siekierski et al., 2018).

The persistent global divide in scientific labor between the Global North and South can be understood from both structural and agency-focused perspectives. Structurally, uneven research conditions—including disparities in infrastructure, funding, and the legitimacy of expertise (Okeke, 2016; Abimbola, 2019; Fricker, 2007; Tetteh et al., 2020; Vasconcellos et al., 2018)—help explain imbalances in task distribution. From an agency perspective, limited opportunities for researchers in LMIC contexts to assume new and advanced tasks perpetuate asymmetries in scientific labor and constrain possibilities for skill development and training (Carvalho et al., 2023; Chinchilla-Rodríguez et al., 2019; Mbaye et al., 2019; Shibayama et al., 2015).

These embedded inequalities continue to shape how responsibilities are distributed and who holds influence in international research collaborations, reflecting the enduring legacies of colonial hierarchies in global science (Harding, 2009). At the same time, the picture is more complex than a simple Global North – Global South divide, as power asymmetries also manifest within and among LMICs, revealing a multilayered landscape of inequality in international research. The findings also demonstrate that, within macro-level structures of inequality, individual researchers and teams can exercise agency within the constraints of their positions. In international collaborations, scientific capital is both accumulated and exchanged among researchers. As trust-based relationships deepen, collaborations can gradually evolve toward greater independence and mutual benefit. Moreover, intentional efforts to allocate roles not only according to existing capacities but also as opportunities for capacity building can significantly enhance the long-term equity and sustainability of partnerships (Chersich et al., 2016; Shibayama et al., 2015).

5.1.3.2. Research Agenda Setting

An important question in global science is how collaboration dynamics among high-, middle-, and low-income countries shape influence over research agendas. Within these enduring asymmetrical structures of global science, institutional theory offers insights into why countries in the Global North continue to exert strong influence over the research priorities in the Global South (DiMaggio & Powell, 1983). This is significant because it highlights the persistent gap between the growing global volume of scientific output and the continued neglect of pressing challenges that disproportionately affect LMICs

(Bhakuni & Abimbola, 2021; Cozzens, 2021; Heeks et al., 2014; Yegros-Yegros et al., 2019). However, institutional theory offers limited insight into the dynamic and evolving nature of these relationships.

As international research networks expand (Leydesdorff & Wagner, 2008; Zelnio, 2012), there is a concurrent convergence of scientific standards and norms (Adams & Szomszor, 2022). High-income countries, with greater access to resources and publishing capacity (Chankseliani, 2023; Collyer, 2018; Sridhar, 2012), therefore wield greater power in determining which topics are studied and how research is conducted.

Within the science diplomacy scholarship, this imbalance is visible in the underrepresentation and marginal network positions of most middle- and low-income countries within the field (Paper II). Such limited participation likely diminishes the visibility of their interests and perspectives in shaping international alliances, influencing scientific discourse, and addressing cross-border challenges, such as climate change and global health crises (Echeverría-King et al., 2023; Gual Soler, 2021). It also reflects the strong influence of North American and European sponsors in defining and steering science diplomacy initiatives.

At the level of international research teams, Paper III showed that the task of conceptualization—the formulation of overarching research goals and aims—is the most frequently reported contribution by both HIC- and LMIC-based researchers for the same publication, across the five contribution types analyzed. Although conceptualization is a somewhat ambiguous category, this finding suggests that co-conceptualization may be more common in international teams than often assumed (Sridhar, 2012). Notably, mobile researchers with affiliations or experience across HICs and LMICs were especially likely to engage in conceptualization. This potentially reflects their dual embeddedness: combining familiarity with LMIC challenges and access to the scientific capital more readily available in HICs, positioning them well to bridge both contexts and shape research agendas (Chand, 2019; Echeverría-King et al., 2022).

Funding remains a central determinant of research agenda-setting, with the vast majority concentrated in high-income countries (Chankseliani, 2023; Collyer, 2018; Sridhar, 2012). Paper V, examining the case of Swedish research capacity building for Bolivian universities, demonstrates that beyond financial support, experience and technical expertise also contributed to Swedish supervisors taking the lead in defining research priorities in highly specialized technological areas—particularly in the early stages of collaboration. While

the broader aims of the program aligned with Bolivia's national priorities, Swedish researchers initially had a significant influence on defining specific research lines. Over time, however, as local research capacity strengthened, Bolivian scientists assumed more active roles in shaping the agenda, including in the supervision of doctoral candidates. Subsequent program phases were increasingly co-developed between research groups at Bolivian and Swedish universities. Sida, the main sponsor, adapted its framework to enhance universities' societal embeddedness and encourage local uptake of scientific findings. This evolution was also driven by tensions among Bolivian researchers who, in the early stages, felt that the emphasis on publication and international visibility conflicted with producing tangible local impact. Their concerns prompted a modification of the program—illustrating that research agendas are not static but can evolve with changing capacities, priorities, and trust among partners.

Findings from the survey in Paper IV further illuminate the factors shaping the formulation of research questions in international projects. Across both HIC and LMIC-based researchers, personal interest consistently emerged as the most important factor—rated on average higher than collaborators' interests. However, LMIC-based researchers placed greater emphasis on practical constraints linked to structural conditions in the scientific system than their HIC-based counterparts, such as funder requirements, the likelihood of publication in target journals, and data availability (Collyer, 2018; El-Khoury et al., 2021; Nobes & Harris, 2019). These findings suggest that researchers in LMICs experience systemic pressures more acutely than their HIC counterparts when defining research problems.

Further analyses of agreement within teams (Paper IV) revealed that HIC-based researchers perceived greater alignment with both HIC and LMIC partners regarding the shared vision of the project. When examining agreement at the level of individual author pairs, those collaborating across income groups showed slightly higher alignment on project vision than those collaborating between LMICs. This suggests that while structural inequalities persist (Matthews et al., 2020; Mbaye et al., 2019), cross-income collaborations may also foster convergence—perhaps through more explicit negotiation of perspectives or complementary roles within the research process.

In sum, the shaping of research agendas in international collaborations is a dynamic and negotiated process. From a structural perspective, institutional norms, funding hierarchies, and the configuration of global research networks create hierarchical conditions within which research agendas are negotiated. From an agency perspective, collaborative practices are continuously

negotiated and adapted within teams and funding arrangements. Together, these perspectives reveal that influence in science is not only institutionalized but also relational and evolving (Emirbayer & Mische, 1998).

5.1.3.3. *Reconciling Perspectives*

International collaboration is often portrayed as an opportunity to bring together shared interests and collectively address complex global challenges (Kuhlmann & Rip, 2019; Gual Soler, 2021; Syed et al., 2012). However, given the persistent asymmetries in international science, it remains unclear whether differing perspectives can be reconciled without compromising the interests of LMICs (Abimbola, 2019; Fricker, 2007). It is therefore important to consider how differences in perspective, resources, and priorities may shape the extent to which partnerships are genuinely equitable and mutually beneficial (Matthews et al., 2020; Voller et al., 2022). Despite the promise of the benefits of international collaboration, comparatively few studies have examined in detail how researchers negotiate differences and establish common ground (Grieve & Mitchell, 2020; Kontinen & Nguyahambi, 2020; Tilley & Kalina, 2021).

Concepts such as *cognitive* and *social proximity*—the former referring to shared knowledge bases and the latter to trust-based, collegial relationships (Frenken et al., 2009; Werker & Ooms, 2020)—help illuminate how researchers working under different conditions connect and collaborate (Moyi Okwaro & Geissler, 2015). These concepts can aid in understanding how researchers from HICs and LMICs reconcile their perspectives and reach agreement, for instance, on individual contributions or shared visions of collaborative projects.

In Paper IV, we analyzed the degree of agreement between researchers based in HICs and LMICs across several dimensions: self-reported agreement with co-authors, alignment in perceptions of the collaborative process, and similarity in how collaborators prioritized factors in defining the research question. The findings reveal notable differences in perceptions: HIC-based researchers generally reported higher levels of agreement with co-authors than LMIC-based researchers. However, overall, researchers reported, on average, high levels of agreement on shared project visions, implying that, even under unequal conditions, researchers are often able to negotiate and construct common ground through collaboration.

Additionally, survey evidence indicates that collaborations are more frequently initiated between HIC- and LMIC-based partners than between two partners

within the same income group (Paper VI). This suggests that—contrary to what some might expect—it is relatively common for researchers from HICs and LMICs to jointly initiate projects, possibly reflecting the perceived complementarity of their resources and expertise.

While this complementarity is a key motivation for collaboration across asymmetrical contexts (Section 5.1.1), Paper V shows that such partnerships are not merely products of strategic exchange. They frequently emerge from aligned interests and a shared commitment to knowledge exchange. In the Bolivia–Sweden case, for instance, researchers and policymakers from both countries jointly addressed issues such as food security and public health by combining their respective strengths. These collaborations were grounded in mutual goals and a sense of shared purpose.

In Paper III, we find that individuals with past or present mobility experience between HICs and LMICs are more likely to engage in conceptual and writing tasks within international research teams. This suggests that mobile and diaspora researchers are particularly well positioned to leverage their knowledge of both contexts, thereby bridging international and local challenges (Carneiro et al., 2020; Chand, 2019; Shrestha et al., 2022).

Taken together, these findings suggest that, despite structural disparities in science among high-, middle-, and low-income countries, researchers—viewed from an agency perspective—can actively build cognitive and social proximity through multiple pathways, allowing them to work toward shared goals even across disparities. Cognitive proximity can emerge from overlapping expertise, prior collaboration, or shared training, while social proximity develops through trust, personal relationships, and repeated interactions (Frenken et al., 2009; Werker & Ooms, 2020). By continuously cultivating such forms of proximity, researchers create common ground that helps reconcile differing perspectives and positions within the global research hierarchy. However, unless the interests and priorities of researchers in the Global South are equally acknowledged, such efforts risk reinforcing Northern priorities.

5.2. Science Policies and Inequality in International Research Collaborations

This section examines the second research question: how science policy sustains or mitigates inequality in global research collaboration. It highlights the dual role of policies, which can either reinforce structural inequalities or create spaces for actors to exercise agency. Policies shape the conditions under which research collaboration unfolds—through funding mechanisms, mobility programs, and capacity-building initiatives—establishing both constraints and opportunities for researchers and institutions. Drawing on theory and empirical cases, I analyze three domains: science diplomacy, researcher mobility, and research capacity building. Across these domains, science policies can either entrench existing inequalities or enable actors to resist, adapt to, and actively transform the dynamics of international collaboration. Figure 6 illustrates this interplay.

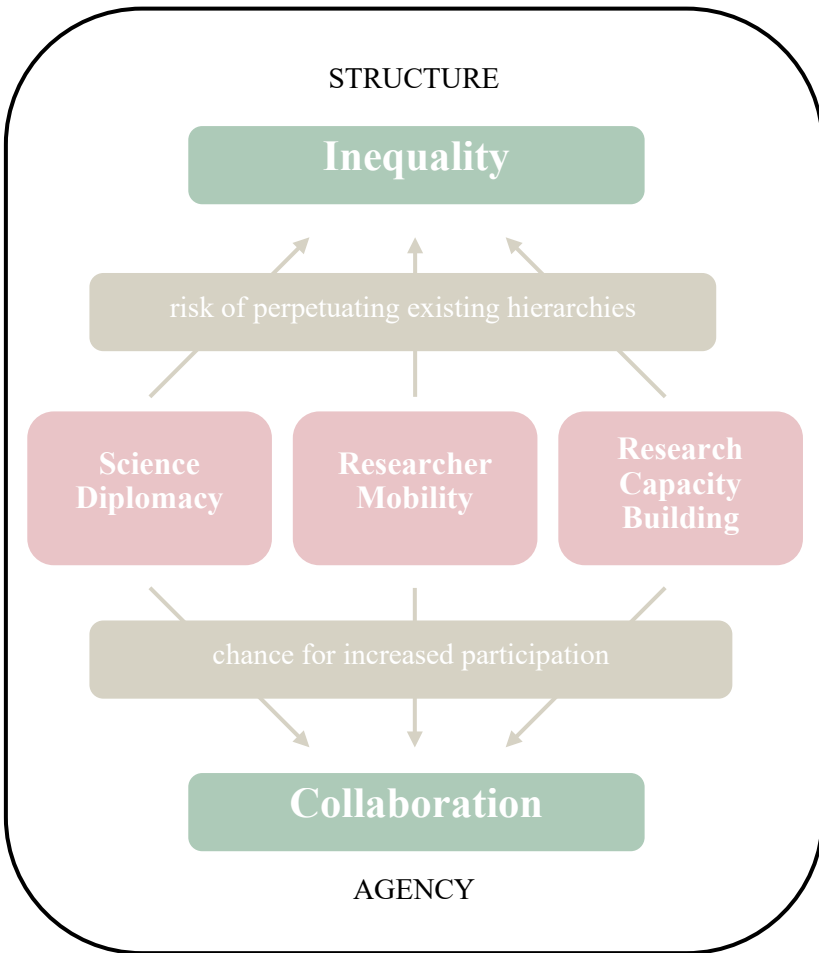


Figure 6. Science policies can either sustain or mitigate inequalities in international collaboration (own depiction).

5.2.1. Science Diplomacy

Institutional theory provides insights into the mechanisms through which norms and practices spread among organizations (Powell & Colyvas, 2008), including universities and research institutions. It helps explain how globally dominant scientific norms diffuse from prestigious institutions in high-income countries (HICs) to low- and middle-income countries (LMICs), leading to convergence in organizational forms and practices through pressures of

institutional isomorphism (DiMaggio & Powell, 1983). In the context of global science, this dynamic contributes to the convergence of norms and practices within largely self-organizing networks, which are typically oriented toward core countries (Adams & Szomszor, 2022; Wagner & Leydesdorff, 2005).

Science diplomacy enables countries to advance both scientific and political interests internationally (Olechnicka et al., 2019; Flink & Schreiterer, 2010). While HICs use it to reinforce established advantages, LMICs increasingly deploy it to expand participation and build research capacity (Echeverría-King et al., 2023; Rüland et al., 2023). In this context, scientific networks as organizational structures can provide insights into the evolution of a scientific field or scholarship, including dynamics of power and the positioning of insiders and outsiders.

Paper II examines the global development of science diplomacy scholarship, revealing patterns that mirror broader inequalities in international science. The field originated in the United States and remains dominated by European and North American-based actors in both authorship and funding. Nevertheless, the analysis indicates gradual diversification, as new actors—particularly from Asia and Latin America—enter the field and gradually assume more central positions within emerging collaboration networks (Rüland et al., 2025).

The network of science diplomacy scholarship across high-, middle-, and low-income countries reveals common features of core-periphery structures in the global science system. The field originated in the United States and has been largely shaped by North American and European authors. This pattern is also reflected in the distribution of funding sources for science diplomacy initiatives. Thus, the ability to engage in science diplomacy and to define strategies aligned with national interests offers many high-income countries strategic advantages, both in shaping their global scientific positions and in attracting collaborators and mobile researchers. While a few middle-income countries, such as India or Brazil, have increasingly invested in science diplomacy to strengthen their international presence and improve their strategic standing, most middle- and low-income countries remain significantly underrepresented in the field. This underrepresentation likely reflects not only limited access to scholarly forums but also more fundamental exclusions from strategic alliances and the processes through which goals of scientific advancement are defined.

We find that, despite the strong emphasis especially by science diplomacy practitioners, on the field being international, the majority of scholarship remains nationally oriented, both with regard to authors' affiliations and the

geographical areas studied (Paper II). This suggests that science diplomacy continues to place considerable emphasis on advancing national interests, while its potential as a mechanism for addressing shared global challenges remains comparatively less pronounced.

These findings highlight persistent inequalities in science and the enduring influence of institutional norms. The trajectory of science diplomacy reflects a typical core–periphery structure and evolution seen in many scientific fields (Zelnio, 2012). The core regions also occupy the most central positions in collaboration networks, with diversification occurring only gradually over time. The spread of the concept from the Global North to the South exemplifies broader patterns of knowledge transfer (Connell, 2014; Das et al., 2013) and underscores the political implications of power and representation in this practitioner-driven field (Olechnicka et al., 2019).

At the same time, the growing diversification of the network suggests that these structures are not entirely static. Over time, several shifts indicate emerging possibilities for agency within the global science system (Powell & Colyvas, 2008). As more peripheral regions connect to the network, new actors emerge, and low- and middle-income countries increasingly employ science diplomacy to strengthen scientific and political participation, build research capacities, and facilitate collaboration and mobility (Echeverría-King et al., 2023; Rüländ et al., 2023). Governments in several middle-income countries with strong technological capacities—such as Brazil and India—have invested in science diplomacy, including research on the topic itself (Rüländ et al., 2025). The emergence of these actors points to a slowly diversifying and potentially more multipolar network. It highlights how targeted funding and institutional support have enabled several middle-income countries to move from passive participation to more actively shaping global discourses. Nonetheless, large parts of the world remain marginalized from science diplomacy networks.

Beyond influence at the level of national policymaking, forms of agency also emerge within global scientific communities and publishing structures. Publishers and segments of the academic community have begun responding to calls for greater geographical diversity by introducing collaboration requirements in calls for papers and dedicating special issues or edited volumes to initially underrepresented regions, such as Latin America—steps that have had a notable impact within the emerging science diplomacy community (Rüländ et al., 2025). These developments illustrate the potential for reconfiguration and change within the realm of scientific publishing (Beigel, 2014; Collyer, 2018; Salager-Meyer, 2008; Schmidt, 2020).

Overall, the evolution of science diplomacy highlights the interplay between structural constraints—such as unequal resources and the dominance of central actors—and agency, reflected in the capacity of peripheral actors to enter and influence global scientific networks through deliberate efforts, including targeted funding schemes and publishing initiatives within the scholarly community. While institutional norms continue to shape participation and influence in science, actors can strategically mobilize science diplomacy as a means to renegotiate these structures and expand their presence within global knowledge production.

5.2.2. Researcher Mobility

World-systems theory provides a framework for understanding the persistent macro-structures of inequality in international science (Schott, 1998; Wallerstein, 1974; Demeter, 2019; Zelnio, 2012), characterized by a pronounced core–periphery structure with semi-peripheries in between (Hwang, 2008). These hierarchies are reflected in patterns of scientific mobility, where the “pull of the core” results in highly asymmetrical flows of researchers (Chinchilla-Rodríguez et al., 2018; Czaika & Orazbayev, 2018; Sugimoto et al., 2017; Verginer & Riccaboni, 2020; Siekierski et al., 2018).

Much attention has been devoted to return migration (Jonkers & Cruz-Castro, 2013; Martinez & Sá, 2020; Saxenian, 2005), while less attention has been given to the more complex trajectories of scientists navigating between core and periphery, acting as brokers across networks and communities (Díaz-Faes et al., 2023; Gonzalez-Brambila et al., 2013; Schiller & Revilla Diez, 2008), or contributing to scientific diasporas (Carneiro et al., 2020; Palacios-Callender & Roberts, 2018). These individual movements illustrate how researchers operate within and across structural boundaries, revealing micro-level responses to global scientific inequalities.

Researcher mobility is closely intertwined with international collaboration, serving as a key mechanism through which ties—particularly between peripheral and central regions—are established and maintained. Mobility allows individuals to accumulate and exchange scientific capital (Bauder, 2015; Koch et al., 2025; Walsh et al., 2016) while strategically navigating institutional contexts that may either enable or constrain their movement. In this sense, mobility can be seen as a form of agency exercised within the persistent structures of the global scientific system.

In Paper III, we analyze the division of tasks in international teams, with particular attention to mobile researchers. By accounting for both current and past mobility across income groups, we capture the fluid and dynamic nature of researcher identities, moving beyond static or binary categorizations of researchers as solely HIC- or LMIC-based. The findings reveal that not only current country affiliation but also researcher mobility significantly influences the types of tasks scholars undertake within collaborative projects.

LMIC-affiliated researchers with past or present ties to HICs exhibit task profiles more similar to those of HIC-based researchers than to non-mobile LMIC peers. Moreover, conceptualization and writing are roles most frequently performed by mobile researchers, whose experience across contexts enables them to bridge perspectives and access diverse types of resources. In contrast, data collection and materials provision are more commonly performed by stationary LMIC researchers, while data analysis is predominantly carried out by stationary HIC researchers. These patterns suggest that mobile researchers who bridge both settings are uniquely positioned to assume conceptual roles due to their contextual understanding of LMIC challenges and access to scientific capital concentrated in HICs.

The Swedish–Bolivian collaboration examined in Paper V further highlights the importance of mobility for capacity building at both individual and institutional levels. Mobility was embedded in the cooperation’s design, notably through “sandwich” Ph.D. programs that enabled candidates to spend time at universities in both countries. Such mobility is considered a cornerstone of research capacity building, facilitating the transfer of knowledge, exposure to international academic environments, and the creation of transnational professional networks. Even after local Ph.D. programs were established at Universidad Mayor de San Simón in 2019—funded by Sida—shorter research stays in Sweden remained integral to researcher training. Nonetheless, prolonged mobility also poses personal challenges, particularly for researchers with caregiving responsibilities.

Scientific inequality between the core and periphery represents a structural condition to which individuals and institutions actively respond, exercising agency through policies and strategies of mobility and relocation. While mobility is a key driver of integration in the global scientific system and a channel for disseminating knowledge and norms, its benefits are often unevenly distributed, contributing to the concentration of scientific capital in core areas (Siekierski et al., 2018; Verginer & Riccaboni, 2020).

Researcher mobility is still predominantly viewed as a one-way movement from peripheral to core regions (Schott, 1998), primarily facilitating the valorization of capitals concentrated in the core. This pattern is reinforced by the abundance of scientific capital—both material and economic resources (Wakunuma et al., 2021)—and symbolic capital, such as markers of recognition (Gerhards et al., 2018). However, mobility also carries the potential to foster exchange and mutual learning, enabling researchers from LMICs to introduce diverse experiences and perspectives that may, over time, contribute to a more pluralistic global science (Escobar, 2017). Ideally, mobility would facilitate a bi-directional exchange of knowledge between contexts, but existing asymmetries often make this difficult. Researchers moving from high-income to low- and middle-income countries typically do so with a different habitus, purpose, and implications than those moving in the opposite direction (Gunasekara, 2020; Martinez & Sá, 2020; Tilley & Kalina, 2021). While researchers from LMICs are often expected to move to the core to learn or build capacity, those from HICs primarily engage to study or intervene. Reversing or balancing these roles—and the assumptions underlying them—could create more reciprocal and transformative learning opportunities.

For such potential to unfold on more equitable terms, several preconditions need to be addressed. These include asymmetrical barriers imposed by policies such as travel bans and visa restrictions (Chinchilla-Rodríguez et al., 2018; Orazbayev, 2017), which hinder the free flow of people and knowledge. They also involve the ways in which researchers from the Global North engage in mobility, for instance, through their habitus (Tilley & Kalina, 2021) or exploitative practices such as “helicopter research” (Kyobutungi et al., 2021; Moyi Okwaro & Geissler, 2015).

Opportunities for mobility are also unevenly distributed, reflecting intersectional inequalities across national, gendered, caregiving, and economic lines (Demeter, 2019; Morley et al., 2018; Schaer et al., 2017; Tomassini et al., 2025). Accordingly, the strong emphasis on mobility in science policy (Jacob & Meek, 2013) risks overlooking structural disadvantages faced by those who remain stationary. Without equitable opportunities for mobility, researchers in the peripheral regions of the global science system continue to face significant barriers to full participation—especially in leading roles—within international collaborations.

Thus, mobility simultaneously reflects and reproduces structural inequalities while providing a means through which individual researchers can exercise

agency, build capacity, and negotiate their position within the global scientific system.

5.2.3. Research Capacity Building

Postcolonial theory has shown that research systems continue to be shaped by colonial legacies (Harding, 2009) and persistent structural dependencies (Alatas, 2022; Mignolo, 2011). In this context, research capacity building is a highly debated practice. On the one hand, it is criticized as a mechanism through which countries in the Global North continue to exert influence over those in the Global South (Mormina & Istratii, 2021). On the other hand, it holds the promise of fostering greater autonomy and strengthening local research capacity in low- and middle-income countries, thereby reducing dependency over time (Beran et al., 2017; Brodén Gyberg, 2023).

Research capacity building—typically supported through funding from high-income countries to low- and middle-income countries (Chu et al., 2014)—aims to strengthen the ability of institutions and individuals in these countries to conduct research independently. Depending on how they are designed, these efforts may involve long-term investments in both human capital and infrastructure and are frequently embedded within international research collaborations (Bradley, 2008; Nilsson & Sörlin, 2017; Wagner et al., 2001).

While postcolonial theory exposes the enduring inequalities that shape global science, it often portrays relationships between the Global North and South as largely static. Acknowledging this structural persistence, the following examples highlight how these relations are simultaneously enacted and negotiated within the situated dynamics of evolving collaborations. In this context, the collaborative building of research capacity appears almost inseparable from the building of proximity.

In Paper V, we traced the evolution of research capacity building between Swedish and Bolivian universities over more than twenty years. Taking the perspective of public universities in Bolivia and drawing on the developmental university ideal of knowledge democratization (Arocena et al., 2015), we examined how these institutions navigated the balance between building scientific capacity through foreign support while avoiding dependency.

The relationship evolved dynamically over time. Building capacity for complex technological tasks, such as advanced materials analysis, required time, several researcher cohorts, and the establishment of local laboratory infrastructure. Over the years, increasing trust in local capabilities enabled

greater task independence for the Bolivian universities. Initially structured around supervisor–supervisee arrangements, many partnerships between Swedish and Bolivian researchers gradually transitioned into more interdependent forms of collaboration.

Interviews with Bolivian and Swedish researchers and policymakers reveal that capacity-building practices were learned in practice and modified over time. As fundamental preconditions—such as infrastructure and researcher training—were established, research agendas became both more scientifically sophisticated and better aligned with local societal challenges (Acevedo, 2018).

Capacity building occurred on both sides of the partnership. While Bolivian researchers strengthened their scientific competencies, Swedish researchers also developed new skills and perspectives. Through supervision and collaboration, Swedish researchers gained new experiences and insights into different environments—learning how to conduct science under resource constraints (Srinivas & Sutz, 2008) and how to engage more effectively with non-academic stakeholders, such as local communities and NGOs.

Paper III complements these insights by examining the extent to which researchers from high-income and low- and middle-income countries engage in the same tasks within a collaboration. This analysis highlights how responsibilities are either shared or divided across international research teams.

We found that certain tasks—such as conceptualization and investigation—tend to involve more joint contributions between authors affiliated with high-income and low-income countries, compared to collaborations between high- and middle-income countries. Such joint involvement may signal close collaboration, active mentorship, or capacity-building efforts. These patterns could reflect additional training provided within international collaborations across disparities (Wagner et al., 2001) and may sometimes conflict with the most efficient division of labor based on existing expertise (Haeussler & Sauermann, 2020; Shibayama et al., 2015). Conversely, a more distinct division of tasks – where each researcher works more independently – can indicate growing specialization and mutual trust within international collaborations. It may also reflect the development of local expertise, as clearer responsibilities signal confidence in each partner’s ability to contribute independently.

Together, the findings from Paper V and Paper III highlight the evolving and relational nature of collaboration in capacity-building contexts. The dynamic nature of proximity across various dimensions—geographical, as physical closeness facilitates collaboration (Torre, 2008; Werker & Ooms, 2020);

social, in the formation of trusting relationships (Nilsson, 2019); and cognitive, in the gradual convergence of knowledge bases (Hautala, 2011)—illustrates this clearly. Initially, geographical and social proximity are particularly important for establishing mutual understanding and facilitating knowledge transfer. Over time, as scientific capacity and trust develop, collaboration can increasingly rely on cognitive proximity, allowing it to be sustained even across geographical distance (Nilsson, 2019; Torre, 2008; Werker & Ooms, 2020).

These examples illustrate that, while structural inequalities continue to shape the global research landscape, relationships between collaborating researchers are situated, complex, and evolving. Within the concrete context of practice, researchers navigate the conditions under which research capacity building unfolds. Accordingly, in terms of policy, addressing research capacity building requires both changing structures with regard to funding arrangements (Grieve & Mitchell, 2020), but also *habitus* in how researchers interact within research capacity building contexts (Koch et al., 2025; Tilley & Kalina, 2021). What determines the sustainability of research capacity building efforts is how they are enacted and the extent to which ownership is shared with recipient institutions (Bradley, 2008; Nilsson & Sörlin, 2017). Transparent communication of goals, long-term commitment, mutual benefit, and reciprocity are key markers of collaborations perceived as successful and equitable (Boum et al., 2018; Matenga et al., 2019).

The (partial) withdrawal of several donor countries, such as the United States and Sweden, from research capacity-building initiatives and international collaborations for development poses important questions about the sustainability of past efforts and the challenges that lie ahead. While it is crucial to critically examine the power dynamics embedded in such foreign-funded projects, these initiatives have also provided a significant share of employment opportunities for researchers in resource-scarce LMICs contexts (Ynalvez & Shrum, 2011)—opportunities that are now becoming increasingly uncertain.

5.3. Concluding Discussion: Agency-centered Responses to Structural Inequalities

This thesis set out to explore the interplay between structural inequalities and individual and collective agency in shaping international scientific collaboration. In doing so, it extends existing macro-level theories of

inequality by focusing on the dynamic and situated practices through which collaboration takes place, foregrounding the role of agency in shaping global research relations. This thesis is guided by two overarching questions: (i) how international collaborations reflect and respond to scientific inequalities among high-, middle-, and low-income countries, and (ii) how science policy sustains or mitigates these inequalities in the global research system.

The studies reveal a complex interplay between structural inequalities and individual as well as collective agency in shaping international scientific collaboration. Enduring disparities in resources and power among high-income and low- and middle-income countries are clearly evident. The findings illustrate that these macro-structural conditions are reflected in multiple aspects of collaboration, shaping motivations, barriers to participation, and team dynamics. Additionally, this thesis advances an understanding of how researchers actively navigate and respond to these inequalities by strategically building scientific capital, cultivating networks, and fostering various forms of proximity. It foregrounds the active role of individual scientists in negotiating these constraints as they build careers, establish collaboration networks, and develop relationships across global divides.

Building on these insights, the thesis contributes conceptually by illustrating how agency operates under structural constraint within the global scientific system. While macro-level theories of scientific inequality tend to depict researchers in peripheral contexts as constrained by established hierarchies, this work emphasizes how they also exercise agency in negotiating their positions within unequal structures. By mobilizing resources, alliances, and various forms of proximity, researchers accumulate and exchange forms of scientific capital even under constrained conditions. On the flip side, it also acknowledges the agency of researchers in the core, whose actions and choices in collaboration—such as team-level decisions regarding task division, authorship, or research agendas—hold the potential to either resist, adapt to, or actively transform existing hierarchies. This reframing emphasizes that inequality in global science is not only reproduced through static structures but also through the everyday, relational practices of collaboration that simultaneously offer opportunities for transformation.

Science policy—operating at global, national, and institutional levels—emerges in this framework as both a sustaining and mitigating force. Through diplomacy efforts, mobility schemes, and capacity-building initiatives, policies shape the conditions under which researchers develop scientific capital, networks, and cultivate proximity. Policies that emphasize priorities and norms defined in the core tend to reinforce existing structural asymmetries,

privileging actors already embedded within well-resourced networks. Conversely, when oriented toward equitable partnerships and bi-directional knowledge exchanges, they can facilitate the redistribution of opportunities and resources.

By foregrounding the situated practices and agency of researchers operating within deeply unequal structures, this study complements static and deterministic accounts of inequality in science. It suggests that the global scientific system is both structured and dynamic, shaped not only by macro-hierarchies but also by meso- and micro-level negotiations that accumulate over time. Researchers' career choices, daily practices, and collaborative interactions constitute the micro-foundations through which structural configurations are either reproduced or gradually transformed. In this sense, the thesis advances a process-oriented understanding of inequality in science—one that conceptualizes international collaboration as an arena where agency and structure co-constitute each other through ongoing negotiation (Sayer, 2000; Bashiri, 2025; Emirbayer & Mische, 1998; Powell & Colyvas, 2008).

Taken together, these theoretical insights contribute to a more relational and practice-based account of inequality in global science. While acknowledging that structural constraints, rooted in historical and institutional power asymmetries, continue to shape opportunities for participation and influence, this perspective also shows that the scientific system is multi-layered and dynamic rather than static. It thus aligns with emerging perspectives that highlight possibilities for gradually reshaping global scientific collaboration toward more equitable forms of international collaboration (Walker & Martinez-Vargas, 2022).

6. Outlook and Implications

This thesis has provided comprehensive insights into structural inequalities among high-, middle-, and low-income countries in science, as well as the ways in which researchers exercise agency within collaborations, responding to and navigating these structures. Drawing on a critical realist perspective, Sayer (2000) highlights the tension between studying the world positively—seeking to explain its underlying structures and causal mechanisms—and normatively—considering how it ought to be and how existing social arrangements might be transformed. He argues that critical social science must attend to both dimensions simultaneously. Accordingly, the thesis not only identifies the mechanisms that sustain inequalities in international research but also illuminates how actors respond to them. By emphasizing the interdependence of structure and agency, it highlights how change can emerge from within—through the everyday practices, strategies, and collaborative efforts of researchers themselves.

Assessing current inequalities raises the question of what possible futures for international science might look like, and how to move toward them. The concept of reparative futures (Walker & Martinez-Vargas, 2022) offers one such lens, exploring how collaboration might evolve amid entrenched disparities. The notion of reparative futures emphasizes the interconnections between past harms, present efforts at repair, and future possibilities for more equitable scientific collaboration (Walker, 2024; Myers et al., 2024). Emerging from postcolonial scholarship, the concept shifts attention beyond critique, focusing instead on actionable pathways forward — material, relational, and symbolic.

In this light, several examples from the studies in this thesis illustrate possible entry points for fostering reparative practices within international science. These include creating opportunities for researchers to connect across geographical and institutional divides and building mechanisms that sustain long-term, trust-based collaborations. They also involve working toward more inclusive and representative research infrastructures, such as global databases, and ensuring that less experienced researchers or those in peripheral locations

have opportunities to assume new and more leading roles. Furthermore, reparative collaboration implies co-developing research agendas addressing pressing challenges through ongoing dialogue, recognizing the bi-directional nature of knowledge flows and mutual learning, and equipping universities and researchers in resource-constrained contexts to conduct independent research.

While structural inequalities in global science remain highly persistent, recent years have also seen the emergence of policy initiatives oriented toward more equitable configurations of knowledge production. These developments often follow the ideals of reparative futures. Central to these visions is the promotion of epistemic pluralism—the idea that multiple knowledge systems hold value and should be recognized within global science (de Sousa Santos, 2014). Related concepts, such as the pluriverse (Escobar, 2017; Rafols et al., 2024) and epistemic humility (Jasanoff, 2007; Walker & Martinez-Vargas, 2022), suggest a shift away from universalist assumptions and toward pluralistic ways of knowing.

Beyond conceptual debates, various institutional efforts aim to address scientific inequality, some of which are also reflected in the studies presented in this thesis. These efforts include attempts to diversify journal governance and authorship (Bhaumik & Jagnoor, 2019; Kyobutungi et al., 2021), reform credit allocation in collaborative research (Allen et al., 2014; Larivière et al., 2021), and expand bibliometric databases to better reflect outputs beyond dominant publishing circuits, such as OpenAlex (Priem et al., 2022). In the context of international collaboration, particularly between high-income and lower-income countries, principles of equitable partnership have gained attention (Chandanabhumma & Narasimhan, 2020; Grieve & Mitchell, 2020), as have funding mechanisms designed to address disparities in research capacity (Brodén Gyberg, 2023). Questions of agenda-setting and project ownership are also increasingly foregrounded in debates on research aid and funding flows (Beran et al., 2017; Carvalho et al., 2018). While these initiatives signal an awareness of global asymmetries in science, their long-term effects on structural inequalities remain uncertain.

While science policymakers play a crucial role in reshaping the institutional frameworks that govern knowledge production, this thesis especially highlights the agency of researchers within these structures. Even in persistently unequal systems, researchers—particularly those with access to resources and privileged positions—retain the capacity to make deliberate and potentially transformative choices. Encouraging and equipping researchers to critically reflect on their own practices and positionalities in international collaboration is therefore essential (Shih, 2024).

The self-organization of scientists in international networks (Melin, 2000) becomes increasingly significant as national governments and funding bodies shift focus toward domestic priorities and partially retreat from supporting global initiatives aimed at addressing transboundary challenges (Lynch & Goldenberg-Hart, 2021). In this context, awareness of one's position within the global scientific system can help researchers understand their potential role as brokers or connectors (Llopis et al., 2021)—bridging divides between networks, disciplines, and geographies.

By engaging reflexively with the problems they address and intentionally opening scientific practices to more inclusive participation, researchers can contribute to reshaping the global scientific landscape toward greater equity, reciprocity, and pluralism. Ultimately, advancing science should aim not only to expand knowledge but to enhance human freedoms and capabilities, supporting people's ability to live lives they value (Arocena et al., 2018; Sen, 1999).

7. Conclusion

The goal of science is to contribute to human well-being through the advancement of relevant knowledge. International scientific collaboration occupies a central position in producing knowledge that addresses global challenges. As science grapples with transboundary issues, such as health crises and climate change, collaboration across borders becomes both essential and increasingly complex. This complexity arises from the historical, political, and economic structures within which collaboration is embedded, as well as from shifting geopolitical relationships and the partial withdrawal of influential actors from international engagement. Structural inequalities in science among high-, middle-, and low-income countries can result in the underrepresentation of diverse perspectives and a misalignment between research priorities and pressing societal needs.

Drawing on a critical realist perspective, this thesis has explored how international collaborations both reflect persistent inequalities and demonstrate the agency of actors operating within them. It brings together theoretical and empirical insights to connect macro-structural conditions with meso- and micro-level interactions, suggesting that researchers and policymakers actively negotiate, navigate, and at times challenge these conditions. The analysis indicates that scientists build, exchange, and pool scientific capital, form networks that bridge disparities, and cultivate proximity within collaborative partnerships.

The findings suggest that structural inequalities manifest in multiple dimensions of team dynamics in international collaboration. Disparities in resources and scientific capacity appear to simultaneously act as motivations and barriers to collaboration, influencing the division of labor, agenda-setting processes, and the potential to reconcile perspectives within diverse teams. Science policy emerges as a potential lever in shaping these dynamics. Policy frameworks seem to influence collaboration both structurally—through resource allocation and institutional incentives—as well as at the level of agency, by shaping the opportunities and constraints within which researchers operate. This thesis highlights science diplomacy, researcher mobility, and

capacity-building initiatives as arenas where existing hierarchies may be reproduced, but which also hold potential for fostering more equitable collaboration through deliberate intervention.

Finally, drawing on the notion of reparative futures, this study identifies ways in which science might gradually evolve to address global asymmetries. Researchers who critically reflect on their practices and intentionally foster inclusive collaboration can help transform the global science system toward greater equity and pluralism, advancing knowledge that addresses urgent global challenges.

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