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Review Article

Neocolonialism and the Technopolitics of Specialization: Toward a Reimagination of the Sociotechnical Imaginaries Approach

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Abstract

As a theoretical framework in the Science and Technology Studies (STS) scholarship, the sociotechnical imaginaries approach (STA) has provided a conceptual framework and methodology that not only overcome the deterministic understanding of technological development but also theorized the relationship between society on the one hand, and science and technology on the other. However, as will be pointed out, a limitation of the STA renders it incapable of problematizing what I will call as

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the technopolitics of specialization, defined as the organization of unequal positions based on the capitalist centers' control over techno-epistemic networks set against the backdrop of a neocolonial relation. Such an incapacity glosses over the persistence of neocolonialism and dependency especially in the Global South.

This paper aims to reimagine the theoretical framework of the sociotechnical imaginaries by developing a critical review of its approach. The paper will place in dialogue the most recent and relevant conceptual developments of the STA and the dependency theory of Samir Amin. The paper will present how the most relevant literature concerning the STA work on the assumption that every polity has control over existing techno-epistemic networks from which imaginaries are independently defined. The paper will argue that given the notion of international specialization developed by Samir Amin and presupposed today in the STA, the technopolitics of specialization monopolizes control of the techno-epistemic networks thereby constraining the imaginaries of peripheral countries.

Keywords

sociotechnical imaginaries – technopolitics of specialization – neocolonialism – techno-epistemic networks

1 Introduction

The STA tacitly assume the political and economic independence of polities and/or their local technoscientific institutions, i.e., those institutions, whether state- or civil society-initiated, engaged in the scientific study of technological innovation, development, and organization. These institutions are assumed to independently develop for themselves – and likewise oppose – a sociotechnical imaginary based on existing technical and epistemic networks in the interest of a particular sociotechnical order. The STA presupposes and takes for granted the issue of political and economic sovereignty in the determination of a unique sociotechnical imaginary especially in the case of the peripheries or the Global South. There is a tendency of the said framework to presuppose the autonomy and equality of polities and/or their local technoscientific actors.

However, neocolonialism complicates the issue of polities' autonomy and equality. As defined by Samir Amin (1976, 380), neocolonialism takes place when the old colonial masters dominate or control polities "without direct political interference." Neocolonialism is still a lingering shackle placed on the necks of many developing countries which constrain sociotechnical visions.

This paper aims to reimagine the theoretical framework of the sociotechnical imaginaries by placing it in dialogue with the dependency theory developed by Amin. This paper will present a critical review of *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power* edited by Sheila Jasanoff and Sang Hyun-Kim (2015) – the main proponents of the STA – and the article *Imposing Evenness, Preventing Combination: Charting the International Dynamics of Innovation in American Foreign Policy* by Daniel McCarthy (2021). From this review, I will illustrate how the most relevant literature on the STA work on the assumption that every polity has control over their techno-epistemic networks. As will be elaborated later, these networks are composed of two elements: on the one hand are the technical systems (TS) or the ensemble of technological and technical practices that encompass society and, on the other, epistemic legitimation (EL) or the processes of knowledge generation and legitimation required in the innovation, development, and organization of technical systems. It is from these networks that imaginaries are independently defined. On the contrary, I will argue that given the notion of international specialization developed by Amin, the technopolitics of specialization – defined as the organization of unequal positions based on the capitalist centers' control over techno-epistemic networks set against the backdrop of a neocolonial relation – constrains how peripheral countries control their techno-epistemic networks and likewise define their imaginaries.

The control of the TS and the process of EL allows the generation of sociotechnical imaginaries the construction of which are participated by multiple, opposing, but endogenous agencies – the state with its governmental branches and/or its civil society groups. It can be said that collective human agency is relative to the endogenous control of the TS and the process of EL. The question however is whether this control is equally shared by polities. This paper aims to answer these specific questions:

1. What relation organizes the unequal positions of control and participation between polities?
2. How does the notion of techno-epistemic domination control the production and organization of TS and the process of EL?
3. How ought the STA be reimagined on the basis of the problem of technopolitics of specialization?

These questions need to be clarified if the STA has to make sense with the experience of the Global South.

The paper will be divided into four parts. After a short introduction, the second part will proceed with the reviews of the aforementioned works and elaborate the sociotechnical imaginaries' notion of co-production within the

problematic of international unevenness. Here, I will borrow from Ingrid Foss Ballo the notion of techno-epistemic networks and explain how the control of the TS and the process of EL the possibilities of sociotechnical imaginaries are defined.

The third part will be a discussion of the concept of the technopolitics of specialization within the horizon of neocolonialism through the dependency theory developed by Amin. Specialization will be discussed against the background of capitalist expansionism and will be analyzed according to techno-epistemic domination. It will illustrate how the imaginaries developed in the peripheries, being determinations of neocolonialism, are never neutral but rather loaded with imperialist agenda.

The fourth section will forward preliminary notes on how to reimagine the conceptual framework of the sociotechnical imaginaries by primarily problematizing the current form of technological specialization. It will propose an ontological-epistemic reorientation that primarily problematizes the technopolitics of specialization.

2 Human Agency Re-imagined: the Idiom of Coproduction and the Techno-Epistemic Networks

2.1 *The Sociotechnical Imaginaries Approach*

One of the central questions in STS scholarship and in philosophy of technology concerns the nature of technology's development. While technology undoubtedly develops in terms of its meaning, efficiency, design, and functionality

TABLE 1 The four traditions of philosophy of technology as developed by Feenberg (2003).

Technology is:	**Autonomous**	**Humanly Controlled**
Neutral (complete separation of means and ends)	*Determinism* (*e.g., modernization theory*)	*Instrumentalism* (*liberal faith in progress*)
Value-laden (means form a way of life that includes ends)	*Substantivism* (*means and ends linked in systems*)	*Critical Theory* (*choice of alternative means-ends systems*)

among others, the question concerning its development – i.e., whether it is autonomous or humanly controlled – produced variances of traditions that, while opposed to each other, are rather constructively in dialogue.[1] For example, Andrew Feenberg (2003) expressed this dialogue in a simplified chart that placed into four categories the traditions of philosophy of technology.

Feenberg (2003) explained that, on the one hand, those that consider technology's development to be autonomous either fall under determinism or substantivism. On the other, those that regard technology's development to be humanly controlled fall either under instrumentalism or critical theory. The STA expanded these existing categories and opened an alternative conceptual framework by forwarding the claim that society and technology co-produce each other.

2.2 *Sociotechnical Imaginaries Refined in Dreamscapes of Modernity*

The concept of sociotechnical imaginaries was originally defined by Jasanoff and Kim (2009, 120) as "collectively imagined forms of social life and social order reflected in the design and fulfillment of nation-specific scientific and/or technological projects." A particular nation-state forwards a vision as to how society is to be organized and ordered which, when collectively shared or has become a collective consciousness, becomes a social imaginary capable of mobilizing a people towards the desired ends of society. This social imaginary coproduce and is reflected in the development and organization of the socio-technical order of society. The imaginary in question and the sociotechnical order that is coproduced with it are rooted in the particular and the contingent (McCarthy, 2021, 297). This breaks away from the universalist and unilinear narratives of technological development common in the modernist tradition.

In a more recent intervention titled *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, Jasanoff (2015, 4) refined and extended the original definition of the concept of sociotechnical imaginaries to emphasize that these imaginaries are not only specific to nation-states but can also be articulated in scientific, professional, cultural, social, or corporate institutions. Sociotechnical imaginaries is redefined as "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology." There can be

1 Allan Dafoe (2015, 1048) expressed that "a central issue in the study of technology is the question of agency."

multiple and contending sociotechnical actors that contest and (re)negotiate imaginaries. The different chapters of the anthology work around this redefined concept which the proponents have developed.

Jasanoff (2015, 6) stressed how imaginaries work both in the subjective and the intersubjective levels, allowing members of a social community to be united in "shared perceptions of futures that should or should not be realized." Jasanoff's notion of imaginaries is influenced by several social scientists who provided meaning of imaginaries especially as to how these bring along social and political orders. Two of these thinkers are Benedict Anderson – with his notion of imagined communities – and Charles Taylor – with his concept of a social imaginary. Jasanoff (2015, 6–7) took from both Anderson and Taylor the position that collectivities share a common anthropological vision – thus rejecting the idea of "politics as consisting simply of purposive rational action" – and that through this shared undertakings, big things, like modernity and nationhood, could actually come together. But Jasanoff (2015, 7) did not limit the notion of imaginaries to the macro level – this is basically the content of the refined meaning of the concept. She took from Arjun Appadurai how imaginaries can form in the micro and "operate at substantially smaller scales." Small communities with social imaginaries can inform the development of the social and political order.

But what interested Jasanoff (2015, 7) more are not the conceptualizations of imaginaries themselves but how these inform STS scholarship, especially how they illustrate the coproductionist model that bridges the "epistemic and the normative, the objective and the subjective." The "idiom of coproduction" is an earlier elaboration of Jasanoff (2004, 2–3). She contended that "knowledge and its material embodiments are at once products of social work and constitutive of forms of social life." She further elaborated that "society cannot function without knowledge any more than knowledge can exist without appropriate social supports" (Jasanoff 2004, 2–3). Sociotechnical imaginaries as a conceptual category is believed to offer a better way of understanding not only how technologies develop and are organized in society but also how non-scientific actors get to influence the development of technical systems.

Indeed, Jasanoff (2015, 8) was a bit critical of how these classical accounts of social imaginaries inexplicably omitted a detailed "investigation of modernity's two most salient forces: science and technology." It is also here that Jasanoff invoked George Marcus' notion of technoscientific imaginaries to include the dimension of material technologies. While Marcus and his colleagues eventually failed to realize their aim of introducing a notion of technoscientific imaginaries that encompass the "reflective, visionary thoughts of scientists," Jasanoff (2015, 10) saw their contributions as a "promising starting point." From

Marcus' and his colleagues' version of imaginaries that located imagination in the scientific workplace, Jasanoff (2015, 11) claimed that the book *Dreamscapes of Modernity* investigates how

> through the imaginative work of varied social actors, science and technology become enmeshed in performing and producing diverse visions of the collective good, at expanding scales of governance from communities to nation-states to the planet. This is why [the editors and authors] choose the term sociotechnical (not technoscientific) to characterize [their] elaboration of imaginaries.

The STA developed not only as a critique but also as an alternative to the determinist view of technological development. In their earlier work, Jasanoff and Kim (2009, 119) saw how STS research has "devoted relatively little attention to the promotion and reception of science and technology by non-scientific actors and institutions." Among other consequences to this is the undertheorization of the relationship between science and technology on the one hand and political power on the other (Kim and Jasanoff, 2009). On the side of technology, it is usually assumed that its development is autonomous, having an internal logic of its own whose various technical outputs, while regarded as social in their function or effects, are assumed to be outside the determinations of the socio-political or of the state. Technology produced by the scientific and technical institutions supposedly bear no mark or trace of the socio-political order from which they emerge. This view usually comes from a determinist understanding of technology that generally regarded technological development as something independent of social influence, following a law-like process which only experts in the scientific community are capable of understanding and therefore of realizing.[2] Knowledge-making is distinct and detached from world-making, ascribing to experts such as engineers and scientists "with substantial epistemic authority" (McCarthy 2021, 301). As Ronald Kline (2001, 15495) explained, determinism views the development of technology according to an "internal logic independent of social influence" which consequently means that "technological change determines social change in a prescribed manner." In determinism, it is as if "science acts, while society reacts" (Hurlbut, 2015, 128).

2 Emphasizing the nuances within the determinist tradition, Allan Dafoe (2015) discussed that there is in the determinist tradition a continuum of scholarship which accommodates both hard and soft technological determinism.

As Jasanoff (2015, 2) expressed, the theoretical framework of the sociotechnical imaginaries "resists the temptation to construe technology as deterministic." Against the seeming independence of technologies from socio-political forces, Jasanoff (2015, 2) insisted that "technological objects… are thoroughly enmeshed in society" and are integral components of the social order so that these objects are coproduced along with the ordering and organizing of society.

2.3 *International Unevenness and the Limits of the Sociotechnical Imaginaries Approach in McCarthy's Imposing Evenness, Preventing Combination: Charting the International Dynamics of Innovation in American Foreign Policy*

While the redefinition advanced by Jasanoff not only conceptually enlarged the meaning of the idea of socio-technical imaginaries but also extended agency to other actors, it failed to grasp the international and inter-societal dynamics and conflict in the determination of imaginaries and the socio-technical orders that are concomitant with them. This gap was pointed out by McCarthy (2021, 297) when he contended that

> for all its undoubted strengths, the Socio-Technical Imaginaries approach does not register the causal consequences of inter-societal multiplicity, even as it empirically details its manifestations in imperialist socio-technical projects, the global diffusion of innovation models, and the very construction of 'globality' as a solution to the threats facing modern political power.

As a result of its failure to consider the inter-societal dynamics of power and conflict, the STA assumes the polities' autonomy and equality. The assumption of autonomy and equality derives its support from what McCarthy (2021) explained as the ontology of the universal which equates universality with homogeneity. Homogeneity presupposes the equality and evenness of multiple polities in terms of determining imaginaries. While this may hold true in the context of Western countries or countries that have control over their own techno-scientific networks,[3] the same assumption does not necessarily apply to backward countries whose networks are constrained if not reduced to nil by international dynamics of power. What is at stake here, as pointed out by McCarthy (2021, 297), is the inability of the STA to "register the causal consequences of inter-societal multiplicity," a problem which, I argue, glosses over the persistence of neocolonialism especially in the Global

3 The concept of techno-scientific networks was elaborated by Ingrid Foss Ballo (2015). This will be elaborated in more detail in the next section.

South. While there were indeed interventions in the STA that tried to trace how colonialism shaped the imaginaries of certain countries (Storey, 2015 and Bowman, 2015), the contexts in question were characterized by colonialism where the socio-technical as well as economic, political, and cultural forces of a nation were *directly* governed by Western colonial powers. In this case also, the techno-epistemic networks responsible for the articulation of the sociotechnical imaginaries were governed by Western colonial powers of whose interests were *directly* represented in the parliament, as in the case of Cecil Rhodes in South Africa (Storey 2015, 39). Neocolonialism posits the *indirect* domination – especially as it took place in the postwar years – of formerly colonial powers in the domestic affairs of the once colonized countries through specific domestic agents.

As was pointed out by McCarthy (2021), the STA is punctured with a theoretical gap that renders it incapable of accounting how the inter-societal dynamics of power and influence determine unique sociotechnical imaginaries and their concomitant socio-technical orders. McCarthy rectified the gap by employing Leon Trotsky's notion of Uneven and Combined Development (UCD) to make sense of the prevailing sociological unevenness and how through the latter the US, as an advanced country, creates backward countries according to its own image. McCarthy's intervention required an ontological and methodological move which McCarthy (2021, 303–306) discussed in more detail. At the core of his discussion are the assertions that UCD: 1) "foregrounds modernity as a singular process of human social development" (McCarthy, 2021, 303); and 2) presumes the relational and co-constitutive character of polities which consequently make the international not as a "static structure, but a historically evolving totality" (McCarthy, 2021, 305). The former contended how structure, particularly the international structure, provides the conditions for difference and heterogeneity. Further, the international structure also sets limits and pressures to the point that it influences if not constricts the development agenda of polities, especially the backward ones. The second argued that the international structure is historically evolving. Central to McCarthy's (2021, 305) discussion is the claim that "powerful states promote their technoscientific worldviews, directly and indirectly." For example, he claimed how the US political order "license attempts to impose developmental unevenness globally through the pursuit of universal regulatory policies" (McCarthy, 2021, 311).

2.4 *The Background of International Unevenness and the Control of the Techno-Epistemic Networks.*

The problem of international developmental unevenness is presupposed and is rarely, if not at all, problematized in existing literature of sociotechnical

TABLE 2 Top 5 most cited articles of Google scholar under the search "sociotechnical imaginaries" done last December 12, 2021.

Author/s	Title	Year of publication	Number of times cited
Sheila Jasanoff and Sang-Hyun Kim	Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea	2009	1294
Sheila Jasanoff and Sang-Hyun Kim	Sociotechnical Imaginaries and National Energy Policies	2013	318
Weston Eaton, Stephen Gasteyer, Lawrence Busch	Bioenergy Futures: Framing Sociotechnical Imaginaries in Local Places	2014	97
Ingird Foss Ballo	Imagining Energy Futures: Sociotechnical Imaginaries of the Future Smart Grid in Norway	2015	169
Ulrike Felt	Keeping Technologies Out: Sociotechnical Imaginaries and the Formation of Austria's Technopolitical Identity	2015	140

imaginaries. For example, this can be observed in the top five most relevant articles of Google scholar under the search "sociotechnical imaginaries."

These articles illustrated how sociotechnical imaginaries of national and/or local stakeholders advanced multilinear directions of development of specific technical systems of countries like the United States (US) of America (as opposed to South Korea and Germany), Austria, and Norway. They also notably showed how national and/or their local institutions defined their respective sociotechnical imaginaries by way of a productive relation or tension between and among communities, technoscientific institutions, civil society groups, and the state. These are brilliant interventions that empirically recorded how cultural values inform the development of technical systems and theoretically presented the STA's concept of society and technology's coproduction.

However, they failed to consider or at least took for granted the background of international unevenness. It is understandable since the problematization of unevenness is beyond the scope of their respective interventions. But if the STA considered "comparison" as an "indispensable method for studying sociotechnical imaginaries" to both "identify the content and contours" of these imaginaries and avoid assuming as universal situated and particular epistemic assumptions (Jasanoff, 2015, 24), it has to inform itself with the reality of international unevenness especially when engaging with sociotechnical imaginaries of the Global South.

The aforementioned interventions work on the assumption that techno-epistemic networks are controlled by a polity, including its civil society and/or its state. Techno-epistemic networks are primarily characterized by how they are dedicated and committed to the realization of technoscientific innovations specifically those that respond or contest societal challenges (Ballo 2015, 10). These networks presuppose, on the one hand, technical systems that serve as the conditions for the possibilities of innovation and, on the other, institutions that participate in meaning-making and knowledge-production. Techno-epistemic networks involve two components: the control of 1) technical systems (TS); and 2) the process of epistemic legitimation (EL). The TS refer to the ensemble of devices, practices, and systems produced to execute a particular functionality (e.g., energy generation) to be used in particular social contexts. Epistemic legitimation involves the dual processes of generating knowledge (from scientific and/or popular/cultural constructions) and legitimating whichever forms of knowledge are required to inform the organization and direction of the TS. The techno-epistemic networks express the idiom of co-production.

Central in the analysis of the techno-epistemic networks is the notion of *control* of the TS and the EL. Using Patrick Feng's and Andrew Feenberg's (2008) analysis of the design process of technology, I define control as the polity's capacity to embed, in the process of technological design and development, the technical specifications and social considerations required in producing and organizing TS that fit specific contexts. This control manifests not only in the production and organization of TS in a polity but also in setting it in a particular direction of development according to epistemic considerations of EL. Control takes place within the coproductive processes of production and organization of TS and EL.

TS and EL are presupposed in the imaginaries surrounding the containment of the atom bomb (Jasanoff and Kim, 2013 and Jasanoff and Kim 2009). On the one hand, the TS refer to the US's nuclear-related technologies. On the other, the process of EL includes what Jasanoff and Kim (2013, 191) described as the

"legal regime" required as a containment apparatus – e.g., laws, court decisions, and scientific inputs. The generation of such a containment apparatus manifests the control of the US of its TS guided by the process of EL. Noticeable here is the influence of President Dwight Eisenhower in the process of EL through his ontological framing of the atom as an atom for peace rather than of war (Jasanoff and Kim, 2009, 126). This framing reflects the more general postwar American policy of splitting the atom twice: first as an atom for war managed by the state and the military-industrial complex and, second, as an atom for peace invested by business interests of the fledgling nuclear industry (Jasanoff and Kim, 2013).

The presupposition of control of TS and EL is also evident in the direction and regulation of renewable energy technologies (Eaton, Gasteyer, and Busch 2014). On the one hand, the organization of facilities and bioenergy technologies refer to the renewable energy-related TS in the US (particularly Michigan) and, on the other, the promotion of scientific studies concerning biomass, categorization of popular constructions and framings, and articulation of community technical discourse refer to the process of EL (Eaton, Gasteyer, and Busch 2014). While the process of EL is participated by contesting stakeholders in Michigan, its generation largely defined and controlled the direction of the development of the said TS especially as how it is informed by local discourse.

The same presupposition of both the control of TS and EL as important components for the determination of sociotechnical imaginaries is observable in Ballo's (2015) discussion of the future of smart grid in Norway. In Ballo's case, the role of TS and EL in the articulation of sociotechnical imaginaries is more pronounced. On the one hand, what she mentioned as smart grids and smart meters are examples of Norway's TS in the field of energy production. On the other, what she expressed as an expert-driven direction of smart grid development is an example of how, through a particular form of EL, a particular organization and direction define the said TS. Underpinned by the market logic, what characterized the Norwegian energy sector the past few decades, according to Ballo (2015, 18), is the "increased control of the energy supply system for the energy sector through increased flexibility from consumers." Ballo (2015, 9) proposed to expand the control of these TS by considering in its development not only the views of experts but also perspectives from multiple lay actors informed by post-normal science.

Ulrike Felt's (2015, 118–119) illustration of how the imaginary of a free Austria managed to ban foreign technologies – nuclear and agrobiotechnology – in Austrian soil affirmed that it is only in the control of the TS and the process of EL that a new sociotechnical imaginary take shape – e.g., a nuclear-free Austria. Not that that they do not have these TS. On the contrary, these TS, especially

nuclear plants, are available in their own territories. However, informed by epistemic assumptions rooted in the imaginary of an Austria freed from both foreign and dangerous technologies, popular and state interventions aimed at controlling these TS – i.e., prohibiting from further operating in Austrian soil – gradually took shape.

3 International Specialization and the Emergence of the Neocolonial Relation

3.1 *Samir Amin and International Specialization*

I would complement and enrich the critique of McCarthy by employing Amin's investigation of the center-periphery (or advanced-backward countries)[4] relation to develop what I will call as the technopolitics of specialization. While McCarthy was able to identify the unequal relation of the centers and peripheries resulting from the international structure, he does not so much deal the historical form of this structure. Amin is specifically chosen as he extensively contributed to the theorization of the peripheries' dependency on the capitalist centers. Placing in dialogue Amin's investigations of how this specialization took historical forms and the earlier elaboration of the concept of control of the techno-epistemic networks, I will develop the concept of the technopolitics of specialization which will serve as a framework in the investigation of asymmetrical relations of polities and for the reimagination of the STA.

3.2 *Peripheral Development and the Technopolitics of Specialization*

The notion of specialization pointed out by Amin is anchored on the principle that polities specialize their production activities based on their natural and sociotechnical advantages. This is the principle of comparative advantage promoted by the classical theorists of international trade. The classic example for this is how in the 19th century capitalist centers specialized in industrial production while the non-industrialized peripheries concentrated in mineral and agricultural production to be exported to the centers. Amin's (1976, 133 and 1977, 24) fundamental critique of the theory of specialization is how it is supported by and reinforces unequal trade. While there could be equality and evenness in the sphere of internal trade within industrial countries at the centers, this could be otherwise in external trade between non-industrial

4 For Amin (2014, xix), peripheries refer to the whole world excluding the triad imperialism of the US, Europe, and Japan.

countries in the peripheries and the industrial ones at the centers, given the "uneven levels of productivity" between opposing polities (Amin, 1976, 133).

Amin critically traced the capitalist system of development and how it eventually reached what he described as the generalized-monopoly capitalist stage (Amin 2014, xvi). Along with the said development is the emergence of peripheral capitalism, particularly characterized by the impingement of foreign capital of the centers on the still developing sectors of crafts and industries as well as agriculture in the peripheral regions. Strategically important in the obstruction of genuine capitalist development and the distorted economies in the peripheries is the policy of specialization rolled out by the global capitalist formations at the centers which eventually cemented the phenomenon of dependence (Amin 1976, 133–197). This dependence reflected in the domain of technology, its development, and how it eventually was monopolized by countries at the centers.

The unequal terms of international specialization are brought along with the expansion of capital in the peripheries. In this advanced stage of peripheral development, Amin (1976, 380) insisted how this is characterized by neocolonialism wherein "technological domination … ensures the conditions for reproducing the [capitalist system of production] without control investments and without direct political interference"[5] in contrast with direct political interference under colonialism. Determined by neocolonialism, capitalist expansionism in the peripheries shaped a new form of specialization which enabled what Amin called as technological dependence. Arguing that technological dependence is another aspect of unequal exchange, Amin (1976, 211–212) explained how such a dependence is made possible both by the concentration of knowledge-legitimation processes among transnational companies (TNCs) and the division of software-hardware production of the centers and peripheries respectively, which functionally centralized "decision-making authority and technological innovation" among the capitalist formations at the centers. Given the determining character of the neocolonial relation, it likewise organized not only the differential but also the unequal positions of control and participation between polities from the peripheries and the industrial centers. The new form of specialization in the context of neocolonial technological dependence or neocolonialism is what I will call as the technopolitics of specialization.

Technopolitics of specialization is the organization of unequal positions based on the capitalist centers' control over techno-epistemic networks set

5 For Amin (1976, 380), such is the meaning of neocolonialism.

against the backdrop of a neocolonial relation. Technopolitics of specialization operates on the centers' technical and epistemic domination. Technical domination works on the ontology of technical diffusion and epistemic incompleteness and is globally rolled out through the policy of technology transfer starting in the 1960s. TS are understood as entities to be dispersed – to propel or "catch-up" in economic "development" in regions where they are transferred – but with the concomitant understanding that their transfer excludes or does not completely transfer epistemic contents required in technical production. Epistemic incompleteness takes place within a situation of epistemic domination.

Epistemic domination operates according to the principle of epistemic diffusion with centralized legitimation. While knowledge production is believed to be diffused and localized in many cultural and popular forms or contexts giving the appearance of democratic participation in knowledge production – such as Antonello Zanfei's (2020) notion of the double-network[6] – the question of the process of legitimation is answered not democratically but institutionally. Institutional legitimation of knowledge usually is mediated by institutions tied up with big TNCs (Amin 1976, 189) since they have the financial resources that could enable a good deal of research and development (R&D) activities to inform the technical specifications of innovation with the latest developments in science. Epistemic domination highly undermines the R&D initiatives of the peripheral countries. These initiatives presuppose a great deal of funding. But funding of R&D initiatives in the peripheries, unlike those that take place at the centers, is external as these are financed largely by foreign financial institutions. Amin (1976, 240) explained that the effect of this external funding is that "responsibility for the direction that development is to take lies with those who provide the funds." Rephrased according to the dynamics of technopolitics of specialization, Hurlburt's (2015, 128) critique of determinism that "science acts while society reacts" could this time mean that capitalist and technoscientific centers act while the peripheries react.

As can be observed in Zanfei's (2020, 520) analysis, epistemic legitimation is ultimately aimed at increasing the international marketability of (internally and/or externally produced) knowledge so that even context-specific

6 Zanfei (2020, 516) explained that TNCs today work both on internal as well as external networks, with the latter composed of "firms and institutions that are located outside the boundaries of the TNC." He added that this double-network creates cooperative relations that foster decentralization where localities are accessed as sources of knowledge and used for the application of new technologies. The problem with Zanfei's double-network theory is that it still operates within the framework of the TNC's dominance. It recognizes the value of context-specific information but only to be assimilated to improve TNC's abilities.

information is seen as only instrumental in the extraction of the "economic value from the generic knowledge the TNC is endowed with." While there is the appearance of participation in context-specific knowledge production processes, these processes are ultimately relevant only within their instrumental role of extracting economic value of the knowledge the TNCs are "endowed" with. In this regard, there really is no control, in the sense defined earlier, among actors in the Global South since it is not within their capacity to embed technical specification and social considerations in the production and organization of TS since it is the "economic value from the generic knowledge the TNC is endowed with" that ultimately matters.

The epistemic domination of the centers during the immediate decades of the post-war period was explained by Amin in the concept of technological dependence. The instrumental role of context-specific information and the legitimating function of the TNCs (to extract the economic value of knowledge) run parallel with Amin's (1977, 171) analysis of how technological innovation is ultimately tied up with the principle of efficiency which fundamentally is always in relation to a system: the extortion of surplus value.

The knowledge needed to produce technical systems and the technical systems themselves are never neutral. Especially under the technopolitics of specialization, they operate within the frame of capitalist accumulation and expansion. In their diffusion or transfer to peripheral regions, they also bring with them the "underlying capitalist relations of production" (Amin 1977, 172). According to Amin (1977, 172), these technical systems presuppose imperialism and by being so undermine the hopes of peripheral countries "to ensure for themselves their own ultimate autonomous dynamism" or their autocentric/endogenous sociotechnical imaginaries. What might be considered as shared visions within the polities of the Global South could be no more than neocolonial imaginaries that mirror and ensure the conditions for reproducing imperialism.

4 Conclusion: Re-imagining Sociotechnical Imaginaries: Problematizing the Technopolitics of Specialization

As mentioned earlier, the STA presupposes and accepts as unproblematic unevenness and even specialization. Explaining the sociotechnical imaginaries and national energy policies of the US, South Korea, and Germany, Jasanoff and Kim (2013, 195) pointed out that "if technological specialization and differentiation are not just unavoidable but also desirable consequences of modernity, then this is an outcome to applaud." Unfortunately, the current TNC-dominated form of specialization is certainly not an outcome to applaud since it is governed according to the principle of technopolitics of specialization. Such a

form of specialization operates against the backdrop of neocolonialism. The technopolitics of specialization can be a useful theoretical framework from which to understand Global South imaginaries and set directions for endogenous and independent imaginaries.

The paper proposes that the reimagination of the STA involves informing itself with the problems of unequal positions and specialization through an ontological-epistemic reorientation. Ontological-epistemic reorientation involves the framing of inter-societal relationships within the theoretical framework of the technopolitics of specialization. The nature of inter-societal relations is socially uneven and a kind of attentiveness or knowledge to this unevenness is required to not only assume a critical stand but also formulate a positive position that overcomes the lingering problem of neocolonialism. This ontological-epistemic reorientation challenges the technopolitics of specialization, which gives a privileged position to the Global North in the international and neocolonial control of the TS and EL which today are guaranteed by global institutions of power like the International Monetary Fund, World Bank, and the General Agreement on Tariffs and Trade (Amin, 2014, 17–31).

This reorientation also allows self-reflection on the part of sociotechnical imaginaries scholars to not only be critical of how unevenness contributed to the flourishing of advanced imaginaries at the capitalist centers. This reorientation also enables a critical examination of just how particular imaginaries in the Global North get to be "shared" in the neocolonial landscapes of the Global South. The process of imposition raises critical issues to the idiom of coproduction since, with the technopolitics of specialization, exogenous imaginaries get to undermine the coproductive capacities of endogenous technoscientific agents where these imaginaries are imposed.

This reorientation likewise sets the direction towards the articulation of endogenous and independent imaginaries. Being grounded on a theoretical framework that interrogates the technopolitics of specialization, it critically examines just how sociotechnical imaginaries of the Global South are situated within the neocolonial landscape. Through the framework, future empirical investigations can shed light as to how the innovation, development, and organization of TS in various countries are informed by an EL the control of which is beyond the endogenous technoscientific actors of the country. The framework could also be used to examine how, in the neoliberal era, COVID-19 vaccines are organized in such a way that scientific and technological breakthroughs are rather restricted and promptly enjoyed in polities mostly coming from the Global North. Important factors for the enforcement of the technopolitcs of specialization in the neoliberal period are the systems of patenting and intellectual property rights instituted by the World Trade Organization (WTO) through the Trade Related Intellectual Property Rights (TRIPS). These have facilitated the

monopolization of patents in general and in the concentration of COVID-19 vaccine production in the Global North in particular (*Ibon* International 2021).

It is the contention of this paper that independent sociotechnical imaginaries could only emerge out from the condition of a polity's autonomy, where it has the endogenous control over the process of embedding technical specifications and social considerations in the production and organization of TS. This means the autonomous control over TS and EL and the formulation of an endogenous sociotechnical imaginary by domestic actors. This also means an end to neocolonialism. This assertion for autonomy is explicit, for example, in how Austria managed to ban foreign technologies to determine for itself its own path of sociotechnical development (Felt 2015). As Felt (2015, 111) illustrated it, the imaginary of a free Austria allowed the creation of a technopolitical identity which enabled the country to "choose a different sociotechnical trajectory from its more powerful neighbors." In this regard, sociotechnical imaginaries in the other side of the globe could only make sense if these also are imaginaries for a genuinely free Global South.

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