STRATEGIC MANEUVERING IN BRAZIL'S 5G DEPLOYMENT AMIDST UNITED STATES-CHINA TECHNOLOGICAL RIVALRY

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The rapid advancement of technology highlights the emerging rivalry between the United States and China, particularly in 5G employment. U.S. sanctions on Chinese 5G technologies put significant pressure on Brazil, which seeks to balance foreign influences while advancing its re-industrialization plan. This study uses an institutionalist approach to analyze government documents, corporate papers, and think tank communications from 2017 onwards, examining the political and economic contestations between the U.S. and China over 5G technology, and Brazil's strategic responses to it. The study reveals that Brazil's pragmatic foreign policy aims to mitigate the negative impacts of the U.S.-China rivalry, ensuring Brazil's technological advancement through a dual approach that involves considering U.S. cybersecurity standards while attracting Chinese investments to enhance its digital infrastructure. This strategy illustrates Brazil's pursuit of autonomy in a polarized international environment, securing its technological future amid great-power competition.

Keywords: 5G technology; United States-China rivalry; Brazil's re-industrialization; pragmatic foreign policy; technological advancement.

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MANOBRAS ESTRATÉGICAS NA IMPLANTAÇÃO DO 5G NO BRASIL EM MEIO À RIVALIDADE TECNOLÓGICA ENTRE OS ESTADOS UNIDOS E A CHINA

O rápido avanço da tecnologia destaca a rivalidade emergente entre os Estados Unidos e a China, especialmente no emprego do 5G. As sanções dos Estados Unidos sobre as tecnologias 5G chinesas exercem uma pressão significativa sobre o Brasil, que busca equilibrar as influências estrangeiras enquanto avança em seu plano de reindustrialização. Este estudo usa uma abordagem institucionalista para analisar documentos do governo, documentos corporativos e comunicações de *think tanks* a partir de 2017, examinando as disputas políticas e econômicas entre os Estados Unidos e a China sobre a tecnologia 5G e as respostas estratégicas do Brasil a elas. O estudo revela que a política externa pragmática do Brasil visa mitigar os impactos negativos da rivalidade entre os Estados Unidos e a China, garantindo o avanço tecnológico do Brasil por meio de uma abordagem dupla que envolve considerar os padrões de segurança cibernética dos Estados Unidos e, ao mesmo tempo, atrair investimentos chineses para aprimorar sua infraestrutura digital. Essa estratégia ilustra a busca de autonomia do Brasil em um ambiente internacional polarizado, assegurando seu futuro tecnológico em meio à competição entre grandes potências.

Palavras-chave: tecnologia 5G; rivalidade Estados Unidos-China; reindustrialização do Brasil; política externa pragmática; avanço tecnológico.

MANIOBRAS ESTRATÉGICAS EN EL DESPLIEGUE DEL 5G EN BRASIL EN MEDIO DE LA RIVALIDAD TECNOLÓGICA ENTRE ESTADOS UNIDOS Y CHINA

El rápido avance de la tecnología pone de relieve la rivalidad emergente entre Estados Unidos y China, especialmente en el empleo de 5G. Las sanciones estadounidenses sobre las tecnologías 5G chinas ejercen una presión significativa sobre Brasil, que busca equilibrar las influencias extranjeras mientras avanza en su plan de reindustrialización. Este estudio utiliza un enfoque institucionalista para analizar documentos gubernamentales, documentos corporativos y comunicaciones de think tanks a partir de 2017, examinando las impugnaciones políticas y económicas entre Estados Unidos y China sobre la tecnología 5G, y las respuestas estratégicas de Brasil al respecto. El estudio revela que la política exterior pragmática de Brasil tiene como objetivo mitigar los impactos negativos de la rivalidad entre Estados Unidos y China, garantizando el avance tecnológico de Brasil a través de un enfoque dual que implica considerar los estándares de ciberseguridad de Estados Unidos y, al mismo tiempo, atraer inversiones chinas para mejorar su infraestructura digital. Esta estrategia ilustra la búsqueda de autonomía de Brasil en un entorno internacional polarizado, asegurando su futuro tecnológico en medio de la competencia entre grandes potencias.

Palabras clave: tecnología 5G; rivalidad Estados Unidos-China; reindustrialización de Brasil; política exterior pragmática; avance tecnológico.

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1 INTRODUCTION

The primary objective of this article is to analyze the U.S. political and economic contestations surrounding Chinese 5G technology, and to examine how the Brazilian government has navigated these pressures amidst its own technological

lag and sustainable development challenges. To achieve this, we explore the ongoing competition between U.S. and Chinese public and private actors for technological predominance. The analysis focuses specifically on 5G technology and centers on Brazil's experiences over the past few years, providing insights into how this middle-power nation has been responding to such a competitive scenario.

At the onset, it should be stated that the world has seen tectonic changes in the last two decades. From the brief unipolar moment of the 1990s led by the United States, and its professedly benign path of a neoliberal project of global integration, we witnessed the rapid decline in economic competitiveness in western economies and an associated crisis in the established multilateral diplomatic order. Much of this derived from internal crises still evolving in the U.S. and associated allies, but it is also directly related to the rise of non-Western economic and geopolitical forces, particularly China, India and Brazil.

Much in the same way, today's international context is defined by rapid transformations, many of which involving the proliferations of regional and/or global crises, including the Russia-Ukraine North Atlantic Treaty Organization (NATO) and the Israel-Gaza-Middle East unfolding wars and all the impacts of these wars on supply-demand, prices and inflation etc.; the climate crisis, with technological and geopolitical repercussions related especially to energy issues. This challenging context has led to new economic-financial dynamics that exert pressures of all kinds, including the need to reform the rules that regulate not only trade, finance, but also technological standards. The rapid advancement of technology is increasingly becoming a defining factor in the emerging great-power rivalry, marked by the competition in cyberspace between the United States and China. This new paradigm in global affairs has shifted towards a race for technological self-reliance (Stuenkel, 2020).

The implementation of sanctions by the U.S. against China on cutting-edge technologies impacts the interests of third countries. This is because the extraterritorial reach of the U.S. legal and financial system ends up being irremediable for many of these countries. Latin American countries, especially Brazil, could be greatly harmed in the context of a political orientation of a predominantly exclusionary nature. With strong ties of Brazil with the U.S. and China, the increase in rivalry means that Brazil faces increasingly difficult decisions with these powers. Even American allies, particularly in Europe, remain cautious about the U.S.'s aggressive approach to containing China militarily and technologically. For instance, during his visit to China in April 2023, French President Emmanuel Macron emphasized the importance of maintaining "strategic autonomy" for Europe and positioning France as a "balancing power."

This stance is often interpreted as opposition to the U.S.-led efforts to isolate or contain China (Will…, 2023).

The affected countries need to respond strategically in order to take advantage of any and all space for new coordination and cooperation agendas. To be sure, President Luiz Inácio Lula da Silva (Lula) came to the Brazilian government in 2023, serving a third term, with the promise of reversing the country's technological backwardness in order to improve society's life. His promises are based on the idea that the State must be the "necessary State to be able to direct and induce the country's economic growth." For President Lula, Brazil has a window of opportunities and potential to attract new investments (Verdélio, 2023).

It is precisely based on this guidance that a new industrial policy begins to be put into practice in Brazil under the coordination of the National Council for Industrial Development (Conselho Nacional de Desenvolvimento Industrial – CNDI). A new industrial policy "of an innovative, sustainable and socially inclusive nature". The government aims to overcome the process of early deindustrialization, "which involves a production structure increasingly focused on primary sectors, less robust links between elements of production chains and exports concentrated in products of low technological complexity" (Verdélio, 2023).

Though this could easily be considered to be a legitimate goal, how would a country facing structural challenges regarding scarcity of capital, well-trained labor, and proprietary technology be able to pursue such a path? Without the intention of giving a complete answer to this question, we believe the Brazilian government's strategy is to ensure robust international cooperation commitments so that the country will be able to deliver results related to its industrial policy and at the same time circumvent the strong pressures to ban Chinese investments in 5G technology and the semiconductor industry.

In order to develop this argument, the present article provides an analysis of the U.S. contestations over Chinese 5G technology, and how the Brazilian government has faced the pressures arising from it. Applying an institutionalist lens to political rhetoric and actions related to the dispute between the U.S. and China improves understanding of the central issues that animate the new industrial policy being presented by the Brazilian government. It is worth noting that it is not our intention to carry out a bibliographical review. For the purposes presented here, it is enough to consider the basic assumptions of this analytical approach. The research methodology involves qualitative content analysis of government documents from the U.S., China, and Brazil since 2017, along with position papers and communications from corporate associations and think tanks.

Using keyword searches, relevant documents were collected to analyze statements about Chinese technological companies by officials from the three countries.

The article is organized into five sections beyond this introduction. In the second section, we provide a historical overview of the American policy against Chinese technology companies, in particular Huawei Technologies. The third section highlights the external pressure over Brazilian technical choices in the 5G technology. In the fourth part of the piece, we examine how Lula's government has dealt with these pressures while trying to implement a new industrial policy. We then conclude by presenting our main findings and discussing their main implications.

2 CHINA'S 5G: THE FIFTH GENERATION TECHNOLOGY – IN THE U.S.'S CROSSHAIRS

The U.S. has been the most active hub in knowledge governance. This goes far beyond investments in research and development (R&D), encompassing State involvement in different dimensions, such as: i) acquisition of new technology (prototype/product development); ii) ensuring demand for such innovations; creation of public inventions/intellectual property for private companies to exploit; iii) shareholdings in innovative companies; iv) planning with industries new technological standards to outflank foreign competitors, and so on (Weiss, 2011). The problem, from the U.S. perspective, is that China now appears as the challenger for technological leadership (Rolf, 2021). In fact, while geopolitical relations between the two nations are complex, China's continuing accumulation of power challenges a world order that is shaped to best serve U.S. interests (Gray, 2021).

In effect, it should be noted clearly that the rising global relevance of China in the last three decades has no precedent in modern history in its speed, magnitude, and consequence. Though this process is still unfolding, the next few years are going to be defined by rising economic, geopolitical, diplomatic, and technological disputes between U.S.-led models and policies and Chinese ones. Within these matters, Latin America, particularly Brazil, have increasingly become an area of interest. And though the region has historically been closely associated with the United States and has mostly acted along responsive ways *vis-à-vis* U.S.-led initiatives, 21st century dynamics have helped reshape regional contours, mostly by providing new economic opportunities – though thus far largely by reinforcing traditional commodity-export activities. Depending on what happens next, this scenario could likely change.

Chinese actions in Latin America in the last twenty years have certainly reshaped the historical course of U.S. dominance in the region. China is already the top trading partner or among the top trading partners for every country

in Latin America and Chinese regional investments seem to be on a path of diversification. In effect, while Chinese foreign direct investment (FDI) in Latin America were mostly centered in the areas of energy and mining until about 10 years ago, since then, China has increasingly assumed an important role as financier of activities in additional industries, such as agrochemical, electrical equipment, transportation, and food and beverage. President Xi Jinping, who proposed the initiative of building a community with a shared future between China and Latin America, has consistently signaled his country's interest in deepening relations with Latin Americans during the Forum China-CELAC in 2014. Specifically, in the Ministerial Meeting of China-CELAC Forum in 2018, China formalized its invitation for countries of the region to become partners in the Belt and Road Initiative (BRI), particularly in the areas of technology and artificial intelligence (Ioris and Cepik, 2023).

A central element of the BRI, the Digital Silk Road (DSR) includes investments in fiber optic cables and telecommunication networks, e-commerce, digital security, mobile payment, and space industry. Large Chinese technology companies, such as Huawei, which have been key in the implementation of the projects of the DSR, have a growing presence in Latin America. This represents an opportunity to catalyze the acquisition of new capacities and pursue innovation, but it also could represent a potential new source of conflict, particularly due to the growing rivalry with the United States over leadership in the field of the digital economy. Though China, along with most other industrialized countries, has sought to decouple some of its dependence on foreign suppliers, new venues for partnerships between Chinese and Latin American public and state actors could increasingly assume new dimensions and scale. Brazil's role in this process is pivotal: of the USD 7 billion-10 billion in Chinese investments in Latin America and the Caribbean in 2021, USD 5.8 billion was directed to Brazil (Gallagher, 2023).

It is difficult to imagine that the U.S. would relinquish the power to establish international technical standards and exert ideological influence through sociotechnical systems. Or even the advantage to enjoy strategic political power derived from control or access to data and digital infrastructures, which is what is being contested in the current context (Gray, 2021). In fact, the U.S. wants to assert its primacy over challengers through an aggressive policy, especially in the so-called "chip war", against China, that means, the attempt to force China out of supply chains, in a modern economic world. In this regard, the Professor of Contemporary History and Director of the European Institute at Columbia University in New York Adam Tooze states:

> it goes as far as trying to sabotage and shut down an essentially private company like Huawei. That is the declared goal of American politics. From the U.S.'s perspective, China must not achieve dominance in any of the important strategic economic

> sectors. There has never been anything like this in modern history. This is de facto an economic declaration of war against China (Hesse, 2023).

Such a vision not only guides and justifies the allocation of significant resources in such sectors to promote critical infrastructure and markets under U.S. domains, but also underlies restrictions on certain Chinese technology companies. Huawei, ZTE, Semiconductor Manufacturing International Corp (SMIC), and ByteDance, the company that owns TikTok, are examples of the relentlessness of the U.S. governments through controls on exports, market participation and investments.

2.1 The perspective of the United States on Huawei's Role in 5G technology

Huawei Technologies (Huawei), a global infrastructure leader for Information and Communications Technology (ICT) and smart devices, and one of the most valuable brands in the world, according to Forbes,[6] is an emblematic case among other companies. They were prevented from participating in bids for government purchases and contracts, were restricted in terms of the use of their equipment in critical infrastructure, and were subject to export control measures for specific technologies. The company has faced strong scrutiny from the American authorities over the last few years. With more than 190,000 employees worldwide, the company serves more than a third of the world's population (Na Futurecom..., 2022).

In the last 10 years, its investments in R&D exceeded USD 132.54 billion, which places Huawei as the second company that invests the most in research in the world. By the end of 2021, the company had 110,000 active patents worldwide. According to the Boston Consulting Group, Huawei was ranked as the 8th most innovative company in the world also in 2021 (Na Futurecom..., 2022). The Chinese giant's product portfolio is quite broad, covering from set-top boxes and routers to smartphones, and has quickly caught up with established firms, such as Ericsson and Nokia, particularly when it comes to the machines necessary to run fast 5G networks. As its gear has been installed around the world, U.S. worries have grown that it might contain "back doors" – deliberate security flaws inserted to allow the Chinese state to conduct espionage, or even to attack phone networks themselves.

In 2012, the U.S. House Intelligence Committee released its first report raising concerns over Huawei, as well as ZTE and other Chinese network equipment vendors (Rogers and Ruppersberger, 2012). Since then, both firms

6. Available at: https://www.forbes.com/the-worlds-most-valuable-brands/#4c5ebfd7119c.

have been de facto banned by U.S. carriers.[7] Huawei's plan to restart 5G chip production means that China's independent chip research and development capabilities may achieve a major breakthrough. On July 27, 2023, Nikkei Asia quoted two sources as saying that Huawei and SMIC will put their self-designed 5G mobile chipsets into mass production and that Huawei may make greater progress in high-precision chips. In response, on August 9, 2023, the U.S. government banned American companies from investing in China's sensitive technologies. It also requires reporting on funding in other areas of science and technology to address threats posed by China's advances in "sensitive technologies and products critical to military, intelligence, surveillance or cyber capabilities".

In response to Huawei's launch of Mate 60 Pro, the United States speculated that China had not yet mastered 5-nanometer chip technology. There were three possible sources of Huawei's chips: First, it used the remaining inventory of chips that Huawei had reserved from Taiwan Semiconductor Manufacturing Company (TSMC) before the U.S. imposed sanctions, SMIC processed this batch of wafers from TSMC's semifinished products; second, it used the shadow manufacturing network to break through the U.S. export blockade and obtain a large number of high-precision chips; third, it used chip stacking technology to achieve temporary replacement functions of high-precision chips.

After evaluating China's current independent chip research and development capabilities, the United States believed that on the one hand, the N+1 process yield rate is low (less than 50%) and improvement progress was slow. China can use Chinese semiconductor design tools and foundry services to purchase and process 5G chips, and estimated annual shipments may reach 10 million units. From the perspective of chip precision, China has accelerated its research on using immersion deep ultraviolet (DUV) lithography to manufacture 7-nanometer chips, which can produce single-exposure 28-nanometer chips, double-exposure 14-nanometer chips, and triple-exposure 10-nanometer chips. Foundries avoid using four exposures to make 7-nanometer chips to reduce losses in lower yields.

In 2017, Donald Trump assumed the presidency of the United States, determined to keep Chinese companies in his crossfire. Before leaving the White House, he signed a series of executive orders establishing his particular mode of action. Then, in 2018, U.S. authorities began to sound the alarm of a supposed strong threat against the country by the Chinese 5G technology industry. Specifically, Chris Wray, as Director of the FBI; Mike Pompeo, as Director of CIA; Adm. Michael Rogers, as

7. It is worth noting that regardless of this, they continued to retail user devices, for example, such as handsets, routers, and tablets aimed at the American consumer, and to strengthen partnerships with American companies, such as Intel, Microsoft, and Qualcomm.

Director of NSA; and others, during a hearing in February 2018, at the Senate Intelligence Committee, indicated they were closely monitoring Chinese companies. In Wray's own words:

> we're deeply concerned about the risks of allowing any company or entity that is beholden to foreign governments that don't share our values to gain positions of power inside our telecommunications networks (…) That provides the capacity to exert pressure or control over our telecommunications infrastructure (…) It provides the capacity to maliciously modify or steal information. And it provides the capacity to conduct undetected espionage (United States, 2018, p. 64).

Then, Huawei's founder Ren Zhengfei's daughter was arrested at Vancouver Airport for allegedly defrauding HSBC, besides another three big banks, into clearing transactions that violated international sanctions on Iran. She was subsequently placed under house-arrest for nearly three years. Accusations and suspicions can be as serious as the lack of evidence and corroboration from U.S. authorities that Chinese spooks use Huawei gear to listen in, or that it has ties to the People's Liberation Army (for which its founder and chief executive, Ren Zhengfei, once worked as an engineer). Such vigilante occurrences led China's Foreign Ministry to predictably railed against America's "strong political motives and manipulations" (Britain…, 2019).

In 2019, an Executive Order (Executive…, 2019) declared national emergency and officially barred U.S. companies from using telecommunications equipment produced by firms posing a "national security risk". In practice, Huawei and more than sixty of its subsidiaries and business units were immediately designated to BIS Entity List for allegedly engaging in activities contrary to U.S. security interests. It should be noted that the Entity Listing designation prohibits all American companies and their affiliates from supplying Huawei with goods, services, and intellectual property, subject to prior approvals via Export Administration Regulations (EARs) licenses. In August 2019, the Section 889 of the National Defense Authorization Act began to be implemented with an interim rule officially banning federal agencies from purchasing equipment from the five, specified Chinese companies. In November 2019, The U.S. Federal Communications Commission (FCC) also prohibited contractors from using Federal subsidies (i.e., the Universal Service Fund) to purchase inputs from Huawei and ZTE (Lee-Makiyama, 2021). The Department of Defense (DoD), in July 2020, published additional measures under Section 889. Federal government contractors were banned from using equipment made by the same five Chinese firms anywhere in their production processes. Furthermore, compliance mandated the rip and replace of existing inputs produced by prohibited companies.

Despite Joe Biden's ascent to the White House, the geopolitical divergence in mobile communications networks persisted, with Chinese companies still facing

restrictive measures Lee-Makiyama (2021). The Entity Listing decisions against Huawei remain unchanged, and Biden has maintained the hard line on Chinese 5G sanctions established by the Trump Administration (Biden…, 2024). While companies like Intel and Qualcomm received some exemptions, their licenses were revoked by May 2024 amid criticism that they aided Huawei's resurgence. By August 2023, Huawei had launched a new phone with a sophisticated chip from Chinese manufacturer SMIC, despite U.S. export restrictions. Additionally, Huawei's smart car component business bolstered its revenue, leading to a 9.63% increase, reaching USD 97 billion in 2023, with profits surging by 144.5% year-on-year (Huawei, 2024).

2.1.1 The fierce campaign against Huawei around the world

Despite high pressure from the U.S., the support for America's tough stance is not universal. On the one hand, Australia has banned Huawei from its 5G networks. Japan has passed laws that seem designed to target the firm. Not to mention Canada's cooperation in arresting Meng Wanzhou, in December 2018, at America's request. By July 2024, Germany is set to phase out components made by China's Huawei and ZTE from its 5G network. Mobile operators like Vodafone, Deutsche Telekom, and Telefonica will remove these components from their 5G core networks by the end of 2026 and from access and transport networks by the end of 2029 (Germany..., 2024) .

However, U.S. allies countries have demonstrated resistance to the pressure on banning Chinese technology. The German government has announced a security review of all critical components provided by Chinese manufacturers Huawei and ZTE. The review is part of a broader effort to comply with the European Commission's Toolbox on 5G Cybersecurity measures, which requires member states to identify high-risk technology suppliers and apply necessary restrictions to mitigate risks (European Commission, 2023). In effect, many of the leading carriers, including Vodafone and Deutsche Telekom, use the company's equipment, and a widespread ban would result in costly changes that executives have warned would delay the debut of 5G in the region. They have expressed concerns about the feasibility of removing and replacing Chinese technology within the proposed timeframe (Le Maistre, 2023).

Great Britain, under strict precautions through a laboratory run by the National Cyber Security Centre (NCSC), part of the Government Communications Headquarters (GCHQ), Britain's electronic-spying agency, allows Huawei's kit (America..., 2019b). Speaking at a security conference in Brussels, on February 20th of 2019, Ciaran Martin, a member of GCHQ's board, confirmed that after having been probed Huawei's hardware and code for years, GCHQ found no evidence of back doors. Despite some criticisms, such as that

"Huawei's code is a spaghettified mess full of holes and weak security", Britain cannot afford to dispense with Chinese investments. All in all, under continued U.S. pressure, Britain finally established a deadline to remove all Huawei gear from Britain's 5G networks by the end of 2027. This decision follows the designation of Huawei's 5G networks as a high security risk in 2020 (UK…, 2022). The UK's mobile providers are prohibited from purchasing new Huawei 5G equipment and are required to remove all existing Huawei 5G gear from their networks by 2027 (Kelion, 2020). Italy, in turn, has granted conditional approval to Vodafone for its 5G deal with Huawei, requiring the company to comply with specific security measures (Italy…, 2021).

These positions indicate that countries, whether close allies or not, are reluctant to choose sides. It appears more pragmatic to focus on the security of the technological system rather than the origin of the company or the capital invested in producing the technology. For some nations, the challenges arising from this dispute can be used as negotiating leverage to secure more advantageous terms in partnerships with either the U.S. or China. This has been the case of Brazil, as will be detailed below.

3 BRAZIL'S INITIAL MANEUVERING ACTS WITHIN A CONTEXT OF RISING UNITED STATES-CHINA TECHNOLOGICAL DISPUTES

Historically, Brazil's telecommunications sector has grappled with tensions between technical considerations and geopolitical influences. In the late 1990s and early 2000s, the National Telecommunications Agency (Anatel) deliberated upon the frequency technology to be adopted for the continued proliferation of cell phones in Brazil. Notably, Anatel resisted pressure from North American interests and opted to auction frequencies compatible with the European standard, exemplified by companies like German Siemens, utilizing the 1.8 GHz frequency band and GSM technology for mobile telephony. This decision engendered competition in the market, ultimately overshadowing the North American frequencies, namely 1.9 GHz, employed for cell phones utilizing the Code Division Multiple Access (CDMA) and Time Division Multiple Access (TDMA) technologies, represented primarily by companies such as Motorola. In Brazil, it was predominantly associated with the Brazilian telecommunications operator company Vivo. Anatel's stance was not without resistance, as it faced lobbying efforts from members of the government and representatives of American companies (Pereira, 2020).

The fifth generation of mobile communication (5G) surpasses previous generations with its speed and potential to drive innovation in artificial intelligence and the Internet of Things (IoT). It enhances IoT technologies by connecting numerous users and devices with high speed, data transport capacity, and reliability.

Besides optimizing current functionalities, 5G can expand IoT applications by enabling innovations previously hindered by connectivity limitations (CNI, 2021). Its main appeal lies in promoting massive, low-cost machine-type communication. In manufacturing, 5G serves as the backbone of the industrial internet, integrating information technologies into the manufacturing sector, generating productivity gains, and altering production relations (Prestes, 2022, p. 3).

Huawei has been present in Brazil for 24 years, leading both the national fixed and mobile broadband markets through strategic partnerships with major telecommunications operators. The company provides integrated solutions across various sectors, including public, private, financial, transport, mining, energy, and cloud services (Huawei..., 2023). Since the 1990s, Huawei has evolved its technologies from 2G to 4.5G and supplies equipment to telecommunications operators. Additionally, Huawei is involved in strategic projects such as constructing the submarine cable between Brazil and Cameroon (Wen, 2020).

With Huawei operating in the Brazilian market, things have not been different in terms of pressures on Brazilian technical choices. During the then-President Jair Bolsonaro's official visit to the U.S., in March 2019, Brazil was urged to ally with the U.S. to limit China's influence in Latin America. Halting Huawei's participation in 5G would be a key element in this process. In 2020, it is evident in Brazil that there was a politicization of the 5G issue, "in order to provide greater alignment with U.S. interests and create opposition with China and its IT companies" (Sousa et al., 2021, p. 80). Supposedly, this would contribute to achieving the objectives of Brazilian Foreign Policy. In particular, the U.S. support for Brazil's candidacy for the OECD and greater guarantees regarding the Brazilian status acquired in the NATO as a major non-NATO ally (Stuenkel, 2019). Additionally, various U.S. government representatives regularly visited Brazilian top authorities during the Bolsonaro government, warning against the alleged risks of endorsing Huawei (Wiziack, 2020).

In specific, an American delegation, led by Secretary of State Mike Pompeo and Advisor to the President for National Security Affairs Robert O'Brien, arrived in Brazil that year to carry out an open campaign against the Chinese company. While some members of the U.S. delegation tried an approach that might appear softer, stating that the U.S. was willing to finance "any investment" in the telecommunications sector, Robert O'Brien expressed his fear about the possibility of Huawei to set up the 5G network in Brazil (Pereira, 2020).

It is noteworthy that during the visit, a Memorandum of Understanding was signed between the Ministry of Economy of Brazil and the Export-Import Bank of the U.S. (EximBank). This agreement encompasses a credit provision of USD 1 billion, targeting various sectors, including telecommunications,

specifically for the implementation of 5G technology (Martello and Mazui, 2020). Along similar lines, former U.S. ambassador, Todd Chapman, indicated that Brazil could access financial support from the International Development Finance Corporation (IDFC), conditional upon Brazil making technological choices that excluded Chinese companies, specifically favoring non-Chinese firms in the development of 5G technology (Mello, 2020). When queried about whether discussions on this matter had taken place in Brazil, involving either the government or telecommunication operators (Telcos), Ambassador Chapman responded affirmatively: "There were some conversations in Brazil, including with my participation. And this is also happening in other parts of the world, it's not just in Brazil that we want to work with Ericsson and Nokia." Citing some countries that would have vetoed the use of Huawei equipment in 5G infrastructure – Australia, Denmark, Japan, Canada –, he said that "more and more countries are realizing that this is not a commercial issue, it is a national security issue and the security of the economy itself" (Mello, 2020).

Former Brazilian President Jair Bolsonaro expressed hope for alignment with the U.S. by considering concerns about "sovereignty, data security, and foreign policy" in his decisions. However, despite this apparent alignment with President Donald Trump, key Brazilian figures such as Vice President Hamilton Mourão and the Minister of Agriculture Tereza Cristina opposed any Huawei ban due to its substantial market share in Brazil's telecommunications sector. They argued that excluding Huawei would hinder the timely and cost-effective deployment of 5G technology, as it would necessitate replacing existing equipment incompatible with competitors' 5G technology – Huawei held between 40% and 50% of shares in Brazilian companies in the telecommunications sector (Wiziack, 2020).

The then speaker of the Câmara dos Deputados (Lower House), Rodrigo Maia, questioned ambassador Chapman's position. Maia pointed out that Brazilian telecoms had been working with Huawei for years – since the implementation of 2G in the 1990s, to more recent technologies, such as 4.5G – and that no concerns about national security had been expressed before (Stuenkel, 2019). The Speaker's questions about suspected espionage, previously expressed by ambassador Chapman against Huawei, ended up backfiring against the American government itself, which had been the protagonist in the espionage episodes against the ex-President Dilma Rousseff and Brazilian companies – Petrobras – revealed by Edward Snowden (Petrobras…, 2013).

Attempting to de-escalate the situation while remaining objective, Speaker Rodrigo Maia said, "a fifth-generation (5G) telecoms tender in Brazil should not be contaminated by ideological battles with China and more competition will lead to better prices for consumers" (Brazil…, 2020) and that the "supposedly

economically liberal government of President Jair Bolsonaro should focus on free and fair competition" (op. cit.). There was also an attempt by Ambassador Chapman to directly pressure Brazilian telcos. Specifically, he extended an invitation to a private meeting with representatives from Vivo, Claro, TIM, and Oi. The meeting was attended by Keith Krach, Undersecretary for Economic Growth, Energy and Environment at the U.S. Department of State. On the agenda were discussions about the telecommunications scenario in Brazil and the prospects for 5G in the short and medium term (Possebon, 2020).

Then, during a visit to Brazil in August 2021, National Security Advisor Jake Sullivan warned Bolsonaro´s government about possible logistical problems that Huawei would have if it participated in the implementation of the network 5G mobile telephony in Brazil. In a teleconference interview with Brazilian and Argentine journalists, the senior director of the National Security Council for the Western Hemisphere, Juan González, participated in the delegation. He mentioned that Huawei could suffer a possible shortage of chips, with consequences for Brazilian consumers (Figueiredo, 2021).

The increasing pressure from the United States heightened the anticipation surrounding Brazil's 5G auction notice. The draft of the auction rules was publicly disclosed in February 2021, projected to have a substantial economic impact on Brazil, potentially generating USD 1.216 trillion in economic benefits and boosting productivity by USD 3.08 trillion across various sectors, including ICT, government, manufacturing, services, agriculture, and retail. The 5G spectrum auction raised approximately 47.2 billion reais (USD 8.5 billion) (Tomás, 2023). Some points deserve to be mentioned in order to highlight the ways in which, even under tremendous external pressure, Brazil managed to find some important levels of agency.

Anatel's regulations mandated that all Brazilian state capitals should have operational 5G standalone (SA) networks by July 2022. The rollout was planned to continue progressively, with the goal of providing 5G coverage to all Brazilian municipalities by the end of 2029. In practice, the standalone networks employ a new 5G core infrastructure that is entirely independent of the 4G network, with all network elements, including the core, specifically designed for 5G. Although it provides extremely low latency, which is essential for applications that demand rapid responses, it requires more time and investment to implement, due to the need to build a completely new infrastructure. The choice was thus to circumvent the necessity for 5G networks to interface with Huawei technologies prevalent in preceding generations.

While Huawei was not explicitly excluded from the auction, the mandate for SA networks implicitly encouraged the use of newer, more secure technologies.

To do this, telecoms had to respect Release 16 or higher standards established by 3GPP. Nevertheless, the telcos would prefer the adoption of a Non-Standalone (NSA) network, since they have already made investments in 4G in recent years in preparation for 5G. The NSA implementation is faster as new 5G towers and radio antennas are added to enhance capacity and speed. Therefore, the regulation choice for the SA required them to recalculate strategies and augment their investments in the short term to adapt their networks. As a telco source said, "Anatel is trying to impose a business model on us. But it disregards the fact that technology cannot be disconnected from the market. I cannot spend more to build a network if there is no expected return on it" (Possebon, 2021).

Several issues remained unresolved, such as the requirement for telecommunications companies to establish a private security network for the federal public administration to address data security concerns – Rede Privativa de Comunicação da Administração Pública Federal. This controversial point in the 5G auction mandated winners in the 3.5 GHz band to adopt Release 16, supporting very low latency and high reliability for IoT and IoS applications. The commitments to build the secure network were allocated to operators winning national lots for the 3.5 GHz frequency, with high security and encryption requirements. According to Anatel´s notice, the devices should "obey specific regulations" and "observe corporate governance standards compatible with those required in the Brazilian stock market" (Brasil, 2022, p. 1).[8]

Although Anatel's notice did not explicitly restrict Huawei as a supplier for the private network, the Brazilian government retained the policy space to later issue a decree creating legal uncertainty for Huawei,[9] dependent on the will of the Brazilian executive branch (Sousa et al., 2021). The decision not to discriminate against Huawei equipment relieved telecommunications companies, as banning Huawei would have required substantial additional investments. This allowed operators to benefit from Huawei's competitive pricing, facilitating a faster and more cost-effective 5G rollout. Huawei claimed that its equipment maintenance costs were approximately 40% lower than those of its competitors (Tomás, 2021). Huawei supplies equipment to the three largest telecom operators in Brazil – Claro, TIM, and Vivo – which have secured rights to distribute 5G nationwide. As of September 2023, TIM had

8. The Ministry of Communications´ ordinance – Portaria No. 1.924, Jan. 29, 2021 – determined the construction of two infrastructures: i) a mobile network with 4G technology or higher to operate in the Federal District region. This infrastructure must adopt a frequency of 700 MHz with 5 MHz + 5 MHz of spectrum; and ii) a fixed fiber optic network will connect the other Brazilian states, to complement the government's existing infrastructure. Available at: https://www.in.gov.br/en/web/dou/-/portaria-n-1.924/sei-mcom-de-29-de-janeiro-de-2021-301396768.

9. Regarding the private network for the federal administration, the former Minister of Communications Fábio Faria said Huawei was not eligible to participate in the government's private network. However, the restriction would not affect the Chinese company, as it has not shown interest in joining the network (Warth, 2021).

the most extensive 5G network, covering approximately 45% of the Brazilian population with 7,590 cell sites. TIM has been collaborating with Huawei on initiatives such as the "5G City" project in Curitiba, aimed at developing extensive 5G coverage and smart city technologies using Massive MIMO (M-MIMO) networks.

4 LULA'S THIRD TERM AND BRAZIL'S REASSERTED 5G APPROACHES WITHIN THE COUNTRY'S REINDUSTRIALIZING EFFORTS

Since Lula assumed the presidency of Brazil for a third term in 2023, there has been a significant emphasis on advancing the digital economy, addressing climate concerns, and navigating the energy transition. These plans are founded on the new government's aim to promote a national plan of re-industrialization. If at first, the global pandemic was the main cause fot these pursuits, currently, the turbulent geopolitical context continues to underscore the necessity of national plans aimed at prioritizing local investments in research and development of technologies and in supporting local companies in the fields of biotechnology, artificial intelligence, semiconductors and advanced computing.

A vital tool in pursuing these goals is the enlargement of public sphere incentives to increase local production of inputs considered critical, such as semiconductors and pharmaceuticals. The U.S. program defines the concept of a "resilient chain" as one that has the capacity to recover quickly from an unexpected event, with the creation of a robust ecosystem of suppliers. In fact, in the post-pandemic scenario, the Biden administration has sought to reorganize its supply chains along a more autonomous base. There is a clear perception of the importance of building production chains that are more regionally integrated and more resilient to disruptive events in international trade (Issue..., 2023).

As in the U.S. case, Lula's plans connect environmental protection and green transition with the need to re-industrialize Brazil and promote sustainable growth. The administration is particularly optimistic that the New Growth Acceleration Program (PAC)[10] will engender conditions conducive to fostering significant technological advancements for economic development. According to a study conducted by Brazil's National Confederation of Industry (Confederação Nacional da Indústria – CNI), the country's long-lasting lag in innovation, adoption of cutting-edge technologies in industrial production, and the industry's limited contribution to GDP underscore the need for modernization. Accordingly, its Industrial Recovery Plan (Plano de Retomada da Indústria) defines key priorities in the construction of a new industrial policy: such as adapting the production structure to global trends such as digitalization, expanding measures to support

10. See Nova… (2023).

the development of science, technology, and innovation; and competitively inserting companies into global value chains; and strengthening and universalizing actions for qualified human resources at all levels. Furthermore, as highlighted by the CNI, the integration of 5G technology into industrial activities represents a pivotal step towards enhancing the competitiveness of the national industry: "In the telecommunications sector, the expansion of 5G must be accelerated to ensure that Brazil does not fall behind in global technological transformations" (CNI, 2023, p. 38). It aligns Brazil with contemporary production trends, aiming to render production lines more adaptable, decrease costs, enhance input efficiency, and augment the country's engagement in global value chains amidst the digital era.

Despite the characteristic optimism of Lula and Brazil's pressing economic need for rapid re-industrialization, the country he assumed leadership of on January 1, 2023, differs markedly from the one he governed during his first two terms. The current international context is significantly more restrictive and conflict-ridden, the commodity boom that previously fueled economic growth is absent, and domestic politics are intensely polarized. As demonstrated during his campaign, President Lula has adopted a stance of attentiveness amid escalating tensions between the United States and China – often designated as "balancing" foreign policy, in stark contrast to his predecessor, Jair Bolsonaro (Kupchan, 2023; Berg and Baena, 2023). During Bolsonaro's administration, Chinese enterprises preferred advancing business dealings with subnational governments, particularly in economically disadvantaged regions such as the northeast, where Lula enjoys stronger popularity (Boadle and Paraguassu, 2023).

Facing a scenario of economic and technological competition between the U.S. and China, a challenging international landscape for Brazil's partner countries, and cooled relations between Brazil and China during Bolsonaro's government, President Lula decided to act promptly upon assuming office. To stabilize these strategic relations and signal neutrality, he visited the United States and shortly thereafter, in April 2023, embarked on a visit to China, following his meeting with President Joe Biden at the White House. The topic of innovation and 5G technology was addressed during President Lula's visits to both the United States and China, highlighting its significance in his international agenda.

During his visit to the U.S., both Presidents Lula and Biden discussed the need for rapid re-industrialization and economic policies that support middle and lower-class workers. They discussed using technology to enhance job quality and workplace safety, preventing discrimination and exploitation in the digital age. The major agreement signed during this visit was the Partnership for Workers' Rights (Readout…, 2023). Brazil still holds three other main agreements with the U.S. in this particular field and related technologies. The Research, Development,

Testing, and Evaluation (RDT&E) Agreement, signed March 2019 and ratified in 2022 between the Brazilian Ministry of Defense and the U.S. Department of Defense, aims to define parameters for conducting and managing RDT&E activities, potentially expanding to areas like 5G and cybersecurity (Brazilian..., 2021). Notably, Brazil stands as the only South American nation to have ratified such an agreement with the United States. The U.S.-Brazil Protocol on Trade Rules and Transparency, updated in October 2020, includes provisions on good regulatory practices and supports collaboration in areas such as digital economy and cybersecurity (United States…, 2020). Finally, the U.S.-Brazil Commercial Dialogue, held in November 2023, reinforced initiatives to enhance resilient supply chains and expand collaboration on standards, metrology, and conformity assessment (U.S.-Brazil…, 2023).

Beyond the Agreements, the U.S. government released the U.S. Government Progress Report on the Joint Recommendations of the U.S.-Brazil CEO Forum, in December 2023. This report is based on the joint recommendations made during the special session of the U.S.-Brazil CEO Forum held on February 7, 2022, and directs one of its 3 sections toward cybersecurity improvement, protection of critical infrastructure, and collaboration for best practices. According to the report, the U.S.-Brazil Commercial Dialogue's Trade in the Digital Economy Working Group (TDEWG) stated "(…) cybersecurity as a priority area for activity development".[11] This recommendation aimed to harmonize U.S. and Brazilian cybersecurity policies and enhance bilateral cooperation by facilitating a visit of Brazilian officials to the National Institute of Standards and Technology (NIST) to examine U.S. cybersecurity solutions. Furthermore, the Trade in the Digital Economy Working Group (TDEWG) is dedicated to improving regulatory interoperability and supporting Brazil's prospective membership in the Global Cross-Border Privacy Rules (CBPR) Forum. Additionally, the U.S. Trade and Development Agency (USTDA) is financing projects to expand e-government services in Brazil, incorporating robust cybersecurity elements into these initiatives.

The agreements with the United States emphasize safeguarding workers' labor rights within the context of industrial digitalization and addressing the cybersecurity implications of 5G technology. In contrast, President Lula's visit to China was predominantly oriented towards enhancing pragmatic commercial engagements, investments, and partnerships. This indicates that the Brazilian administration is cognizant of China's significant role in the development of information technologies, particularly its leadership in the implementation of 5G technology. Notably, almost 40% of the essential patents for 5G technology are held by Chinese companies (China SCIO, 2022).

11. Available at: https://www.trade.gov/us-brazil-ceo-forum-us-government-progress-report.

Over 20 bilateral agreements were signed, focusing on various sectors such as trade, investment, digital economy, and technology. President Lula visited Huawei's technology development center, where he was briefed on the advancements in 5G. This visit underscored Brazil's interest in expanding cooperation with China in the field. The two nations signed agreements to collaborate on developing 5G infrastructure in Brazil, aiming to enhance the country's digital transformation and low-carbon development efforts. In addition to 5G, the agreements included collaboration on cybersecurity measures.

This is particularly relevant as the U.S. has expressed concerns about security issues related to Chinese technology providers like Huawei. The strategy aimed to strengthen Brazil's cybersecurity infrastructure while benefiting from Chinese technological advancements. Moreover, the agreements also paved the way for the establishment of a semiconductor factory in Brazil, which would help Brazil develop its own semiconductor capabilities, reducing dependency on foreign imports and fostering technological self-sufficiency. This underscores the administration's belief that the adoption of 5G technology will yield substantial productivity gains across various sectors of the economy. In total, the adoption of 5G technology is projected to contribute an additional USD1.3 trillion to the global GDP by 2030, with USD484 billion impact on U.S., USD220 billion on China, and USD36 billion in Latin America (PwC, 2021).[12] As articulated by Prestes (2022), citing the insights of Chen and Kang (2018), "since 5G is in a critical period of standard formation and industrialization, all major countries consider 5G a high priority development area in their national digital strategies" (Chen and Kang, 2018 apud Prestes, 2022, p. 9).

The Memorandum of Understanding on Strengthening Cooperation in Investments in the Digital Economy between Brazil and China outlines the exchange of political strategies, regulations, and standards for the digital economy. This includes "enhancing cooperation in financial payments, intelligent logistics and warehousing, online and offline displays, the IoT, 5G, and other areas" (Brasil-China…, 2023). The cooperation in financial payments is particularly significant, as Brazil and China have also signed agreements facilitating transactions between the Brazilian Real and the Chinese Renminbi without intermediate dollarization.

In this sense, Lula's trip had a discernible purpose: soliciting commitments from China to advance sustainable development and foster the digital economy. The parties had already been preparing to sign a set of technological cooperation commitments, including the study of mechanisms to promote effective collaboration in scientific and technological research and industrial innovation

12. The report did not show comparative value for specific countries of Latin America.

(Memorando…, 2023). In fact, during President Lula's visit, a Memorandum of Understanding (MoU) was signed, establishing cooperation in information and communications between Brazil's Ministry of Communications, the Anatel and China's Ministry of Industry and Information Technology. Jeferson Fued Nacif, Chief of the Special Advisory for International Affairs at the Ministry of Communications, affirmed that the signing of the MoU aligns with the new diplomacy adopted by Brazil and aims to resume multilateral activities that were weakened under previous administrations, and it is crucial for Brazil's projection and participation in discussions on technology and innovation with a major commercial partner like China (Souza and Sousa, 2023).

The overarching objective of the Lula administration is indeed to harness 5G as a catalyst for economic transformation and social inclusion. And the realization of 5G's potential hinges upon the pace and trajectory of its dissemination, necessitating the expansion and modernization of telecommunications infrastructure spearheaded by private enterprises: "the development of 5G infrastructure in Brazil will be essential to support the digitalization and high-speed connectivity necessary for Industry 4.0" (CNI, 2023, p. 50). Furthermore, the realization of its potential to enhance productivity, elevate quality of life, and mitigate disparities relies on the implementation of public policies geared towards its widespread adoption, ensuring equitable access and utilization in the delivery of essential public services crucial for societal well-being. This indicates that a primary objective for Brazil in the development of 5G technology is to ensure the establishment and reinforcement of nationwide support infrastructure. Brazil is one of the very few countries of Latin America to have implemented a universal service regime, with network expansion and quality obligations imposed on concession holders in accordance with binding universal service plans, the so-called General Plan of Universalization Goals (Plano Geral de Metas de Universalização – PGMU) (Anatel, 2019).

The current universal service obligations of concession holders include the provision of individual fixed telephony access in localities with over 300 inhabitants within 120 days. From 2012, the individual access obligation has been extended to rural communities within a radius of up to 30 km from the nearest municipality. Additional obligations are collective access to rural schools, health establishments, and indigenous communities, amongst others.

Similarly, the General Antenna Law (Lei Geral das Antenas) that establishes general norms for the implementation and sharing of telecommunications infrastructure, aimed at harmonizing regulations for the deployment of telecommunications network infrastructure throughout the country, also seeks to promote the expansion of network coverage and thus improve the quality of

services provided to the population (Capitais..., 2022). These rules will accelerate the development of 5G technology in Brazil, which is expected to reach all 5,570 Brazilian municipalities, starting with the capitals and gradually expanding to other cities. However, for coverage to be complete in each city, numerous antennas are required (Capitais…, 2022). According to the Federal Government's portal, the more modern the municipal legislation, the faster the city will have access to extensive 5G coverage. Cities that have already adapted their laws to the General Antenna Law will be the first to receive all the benefits of the new technology. It is important to note that due to the complexity of 5G installation and operation, the auction tender sets annual targets for the gradual expansion of coverage nationwide. It is forecasted that 100% of Brazilian municipalities will be covered by 5G by 2029 (Capitais…, 2022).

In the field of education, sino-brazilian partnerships in 5G have been advancing. The National Service for Industrial Learning (Senai) and Huawei established a partnership in 2021 to provide certified courses in the area of ICT and establish training laboratories for market professionals. The initiative announced three state-of-the-art Fiber to the Home (FTTH) technology laboratories in the Federal District, Bahia, and Tocantins (Huawei…, 2021). Additionally, the ICT Academy MEC/Huawei non-profit partnership program was announced, authorizing universities and colleges to offer Huawei certification courses (ICT Academy..., 2022). In Brazil, over 100 educational institutions are part of the ICT Academy. The partnership allows teachers, students, and administrative staff of partner institutions to receive training sponsored by the company and recognized by the industry, with international certifications in areas such as Cloud, Artificial Intelligence, fiber optics and 5G.

It is evident that if recent technological transformations in the industry have minimized risks, monitored production, and boosted productivity, 5G is of great interest to rural entrepreneurs. The use of 5G in agriculture has already been documented in at least 2 cases: in the intelligent grain crop monitoring project, using drones, in partnership with Huawei-Federal University of Tocantins (UFT); and the inauguration of the Center of Excellence in Exponential Agriculture (Ceagre), a partnership between the university, the municipality of Rio Claro, the government of Goiás, and Huawei (Huawei…, 2023). This latter initiative is an ecosystem dedicated to technological and business advancement, with the purpose of fostering innovation and collaboration, driving competitiveness in the industry, providing business training, and facilitating synergies in research, technological development, and innovation activities among companies and ICTs.

The initiative to Ceagre was led by the Government of Goiás, through the Foundation for Research Support of the State of Goiás (Fapeg), which

plans to invest R$ 15 million over five years. The Excellence Center aims to promote innovation-centered businesses, develop high-value-added technological solutions, and increase the number of agricultural startups in Goiás. Another project is being developed by the Brazilian Agricultural Research Corporation (Embrapa) in partnership with the Cooperative of Sugarcane Planters of the State of São Paulo (Coplacana) in São Paulo. This project includes controlled experiments to evaluate products, image-based identification of problems in sugarcane production, such as planting failures, weeds, and nutritional deficiencies, and real-time monitoring of microclimate variables in experiments (Massruhá, 2021).

The use of 5G in these projects allows for increased frequency and expedited processing of images obtained by drones, as well as real-time monitoring of microclimate variables in experiments, which is crucial for more efficient and sustainable agricultural production. As previously discussed, the advancements introduced by 5G technology play a crucial role in promoting sustainable production practices. This meets the official guideline of the Lula government, which shifted from a more permissive and less alarmist stance to a commitment agenda with energy and ecological transition. In times of international agenda focused on climate change and environmental preservation, the Lula government has emphasized the need to apply sustainable development to the agricultural sector (Leia..., 2023).

In order to achieve the government goals toward re-industrialization and the usage of 5G technologies, the Industrial Recovery Plan indicates the regulations updating and establishing a favorable regulatory environment to facilitate the deployment of 5G networks. This includes allocating resources for the construction and expansion of the necessary infrastructure for 5G implementation, such as transmission towers, fiber optic networks, and data centers. Moreover, through fiscal incentive policies and subsidies, the government can encourage telecommunications and technology companies to invest in the deployment of 5G, covering tax exemptions, low-interest credit lines, and funding for infrastructure projects.

Among the key agreements during Lula's recent visit to China, a MoU on cooperation in information and communication technology was signed, highlighting the commitment to jointly develop 5G technology, leveraging China's expertise and investment in this field. Additionally, another MoU on strengthening investment cooperation in the digital economy was established, which encompasses 5G infrastructure as part of the broader goal of digital transformation and connectivity enhancement in Brazil (Huld, 2023). These partnerships are a continuation of China's strategic investments in Brazilian

infrastructure, which have been a crucial part of their bilateral relations. According to the monitoring of Chinese investments in Brazil conducted by the Brazil-China Business Council (Conselho Empresarial Brasil-China – CEBC), between 2007 and 2022, Chinese companies invested USD71.6 billion in Brazil through 235 projects. In 2022, although the electricity sector had the highest number of confirmed projects (50% of the 32 Chinese ventures in Brazil), the Information Technology sector also stood out, ranking second with a 25% share of projects. This continued interest in Information Technology aligns with the increasing number of households with internet access in Brazil (Cariello, 2023).

5 CONCLUDING REMARKS

Recent policies put in place in Brazil indicate that 5G is a high priority area for the formulation of national development policies in the country. In effect, its synergies in productivity all over the economy along with meeting the government's social/environmental agenda make 5G one of the main goals of Lula's third term, highlighting the importance of adopting public policies that encourage this deployment. Its implementation is seen as a strategic political-economic decision, and the balancing foreign policy adopted aims to mitigate the negative impacts of U.S.-China rivalry. This ensures that Brazil does not fall behind in global technological advancements, while choosing what fits best the country's demands in terms of increasing industrial and institutional digitalization capabilities.

Ensuring the deployment of 5G infrastructure across all 5,570 municipalities in Brazil necessitates rigorous oversight of the implementation of the general antenna law in each city, along with the commitment of companies responsible for disseminating 5G technology, and the sustained flow of investments. Brazil's major challenge will be to align its commitments to the cybersecurity and data usage standards stipulated in bilateral agreements with the United States, while concurrently facilitating and simplifying domestic regulations to continue attracting Chinese investors in the sector. If possible, this synergy would not only enhance the country's digital infrastructure but also facilitate the transition to Industry 4.0 while ensuring the protection of workers' rights. Through this dual approach, Brazil can ensure robust cybersecurity and effective data usage standards, aligning with international commitments and fostering a conducive environment for sustainable technological growth.

What is more, examining the implementation of the frameworks for the deployment and expansion of 5G technology in Brazil highlights the relevance of the middle power's self-defense and autonomy facing big powers rivalry or, put in another way, power politics. Granting room for maneuver in a challenging scenario might include both conceding to rising pressures from the traditional hemispheric

hegemon, i.e. the U.S., while also leaving open the possibility that Chinese actors could still be in Brazil's domestic technological market. It is clear that Lula's more pragmatic foreign policy expanded on Brazil's traditional multilaterally oriented and economically grounded diplomatic efforts. Moreover, at the domestic level, Brazil will have to address the rigid bureaucratic system and the increasing political polarization to facilitate the adoption of updated regulations that expedite the expansion of 5G connectivity as outlined in the Industrial Recovery Plan.

Chinese investment and technology transfer in Brazil can be seen as another example of South-South cooperation, and also the practice of China's concept of a community with a shared future for mankind. Although under tremendous pressure from the U.S. sanctions against China, Brazil has shaken off ideological interference, adhered to an independent foreign policy, and adopted a position of not taking sides between China and the U.S. This is not only conducive to improving the country's industrialization capabilities through cooperation with China, but also lays the foundation for Brazil to play a more important role on the international stage in the future.

Whether this course of events can be sustained will depend largely on the electoral outcome in the United States and how its new president will act *vis-à-vis* China's continued presence in Latin America, Brazil in specific. Additionally, the unfolding of the 5G issue in Brazil amidst the U.S.-China rivalry will also depend on future developments and negotiations in the semiconductor industry and mineral exploration concessions. While not dismissing what Brazil has managed to achieve, this realization certainly nuances the degree to which countries with significant but not global reach capabilities can indeed pursue their interest within a crescent tensioned international scenario. Thus, we conclude that the Brazilian case is perhaps uniquely suggestive and relevant to continue to be monitored in the upcoming years.

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