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Techno-nationalism or technology sovereignty? Comparative evidence from MRI technology development in Türkiye and Brazil[1*]

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Abstract

This paper compares Türkiye and Brazil within a political-economy framework, analyzing how techno-nationalism and technology sovereignty strategies affect technological learning and indigenous production capabilities, specifically in MRI technology development. Rapid technological advancements and geopolitical shifts have triggered governments to reconsider industrial policies, emphasizing technological autonomy, supply chain resilience, and national security. While Türkiye's "indigenous-national" approach exhibited strong techno-nationalistic tendencies, hindering effective technological learning, Brazil's more open, collaborative strategy significantly facilitated technology transfer and indigenous capabilities. MRI technology provides an ideal context due to its complexity, strategic healthcare importance, and concentrated global market dominated by multinational corporations. The findings reveal that Türkiye's nationalistic strategy, characterized by limited institutional alignment and global integration, constrained technological capability building. In contrast, Brazil's strategic localization, supported by structured policy interventions and international collaboration, resulted in effective technological learning and industrial success. This research provides novel insights by examining Türkiye's hybrid strategy (indigenous-national), an area rarely explored comparatively in existing literature, thus enriching discussions on technology sovereignty and techno-nationalism in emerging economies.

Key words: Techno-nationalism, technology sovereignty, Türkiye, Brazil, MRI.

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1. Introduction

In an era of rapid technological advancement, geopolitical shifts have catalyzed accelerated technological development. At the same time, they have heightened external dependencies on increasingly complex technologies. In response, governments have undergone a major change in their industrial policies, prioritizing the reconfiguration and resilience of supply chains, expansion of industrial subsidies, and maintaining financial security, all within the broad aim of supporting technology development and a competitive economy (Mazzucato, 2015; Rodrik, 2004; Mazzucato and Rodrik, 2023, Akçomak, 2024).

Such change is particularly evident in technologically advanced economies such as the United States, Japan, and the European Union, where governments have identified and reinforced national priorities in key technological sectors. As a result, the revival of techno-nationalism in China and South Korea has sparked debates about the balance between economic globalization and national control over strategic technologies. At the heart of this debate lies a sophisticated concept, technology sovereignty, which refers to a nation's ability to develop, control, and regulate its technological infrastructure, resources, and innovations independently of foreign influence (Huang and Soete, 2025). More than just technological ownership, technology sovereignty encompasses policy autonomy, digital rights, and strategic governance over critical technological infrastructures.

The aim of this article is to compare Türkiye and Brazil in a political-economy framework where techno-nationalism clashes with technology sovereignty. In Türkiye, although the "indigenous-national" (*yerli-milli* in Turkish) motto generated enthusiasm towards high-technology production, its practical implementation exhibits stronger nationalistic elements than indigenous technology development. Conversely, Brazil's strategy of supporting technology development has been more open, emphasizing localization and indigenous technology production. Thus, two emerging economies are compared, one pursuing a techno-nationalist strategy, the other embracing a technology sovereignty approach, in the creation and development of technology markets.

Technological self-sufficiency poses particular difficulties for emerging economies, especially regarding the creation of high-tech industries. These countries usually operate in environments where access to global knowledge networks is essential for industrial upgrading and technological learning, yet they also face pressures to reduce their reliance on external sources. Different state strategies have influenced technological learning and, consequently, their potential to achieve technology sovereignty. This tension is clearly visible in the case of MRI production in Türkiye and Brazil (Yavuz, 2024). Years of significant investment and effort stalled due to Türkiye's techno-nationalist posture, whereas Brazil's cooperative approach facilitated a certain level of technology transfer and learning. The findings of this paper indicate that Türkiye's nationalistic strategy, lacking sustained institutional alignment and global integration, ultimately hindered technological learning and capability building. In contrast, Brazil's strategy, characterized by strategic localization, structured policy interventions, and international collaboration, led to successful technological learning and industrial outcomes. Thus, this paper addresses the following research question: How do techno-nationalist and technology sovereignty strategies affect technological learning and indigenous production capabilities in emerging economies, specifically in the context of MRI technology development in Türkiye and Brazil?

MRI technology was selected for this comparative analysis due to its high technological complexity, which requires significant knowledge, specialized skills, and advanced manufacturing capabilities, making it ideal for examining technological learning and capability building. Moreover, MRI is strategically critical for national healthcare systems, rendering it highly relevant for public health and economic policies. The global MRI market, dominated by a few multinational corporations, presents a clear context for analyzing how national strategies aim to reduce external technological dependencies. Additionally, MRI development involves substantial financial investments and risks, necessitating substantial state support, thus allowing an effective evaluation of different government policies. Finally, the distinct strategies pursued by Türkiye (nationalization) and Brazil (localization) in MRI production provide a comparative framework to understand the impacts of techno-nationalist versus technology sovereignty approaches.

This research contributes to the literature by exploring Türkiye's unique case, which blends elements of both techno-nationalism and technology sovereignty. Existing literature predominantly treats these strategies as distinctly separate and opposing models (Lee et al., 2024). However, Türkiye's approach provides an interesting hybrid scenario rarely explored in comparative studies, especially in contrast with Brazil's strategy that comes close to technology sovereignty. Additionally, comparative analyses of emerging economies employing these contrasting approaches are not common, enhancing this paper's contribution to literature.

This research is organized as follows: Section 2 reviews the conceptual frameworks of technology sovereignty and techno-nationalism, emphasizing their strategic goals, policy tools, and global collaboration dynamics. Section 3 explains the research methodology, detailing the qualitative approach and data collection process employed. Section 4 presents a comparative analysis of Türkiye's and Brazil's approaches in the MRI sector, focusing on their respective technological learning outcomes. Finally, Section 5 concludes by summarizing the findings and discussing policy implications, limitations, and recommendations for future research.

2. Technology sovereignty and techno-nationalism

Technology sovereignty is often used synonymously with techno-nationalism. Both concepts focus on the management of technological resources, but we see two very different approaches in terms of strategic approach and political framework (Lee et al., 2024). In other words, it is like two different policies that aim to achieve similar outcomes.

Technology sovereignty aims to deepen technological knowledge in the long run by developing ownership of a country's basic technological needs together with strategic autonomy, and by performing external collaboration when necessary. The aim here is not to ensure complete independence, but rather the ability to act independently where necessary. It is essentially a flexible and practical strategy that acknowledges the intricate interdependencies of global technological ecosystems. For instance, the European Union's framework for Open Strategic Autonomy (OSA) explicitly defines sovereignty not as autarky but as the ability to "develop and maintain key technologies through cooperation with trusted partners" (Kroll, 2024). OSA emphasizes that Europe's ability to maintain leadership in innovation depends on its integration in global knowledge networks, particularly through initiatives like Horizon Europe, which fund multinational research consortia across areas such as AI, energy, and health technologies. Germany's HighTech Strategy 2025, aligned with the OSA vision, demonstrates how sovereignty and global collaboration can coexist. Germany advances its national innovation goals through mechanisms like Horizon Europe while participating in cross-border R&D programs in AI, green hydrogen, and health technology. These efforts underscore the idea that technology sovereignty is strengthened, not undermined, by international cooperation if it is strategically structured. It controls essential technological capabilities while remaining engaged in global networks by encouraging partnerships with trusted international alliances. It aims to prevent the inefficiencies of closed, protectionist policies while ensuring that countries are not susceptible to unilateral dependency (Edler et al., 2016). In this form it is similar to the concept of "local buzz, global pipelines" (Bathelt et al., 2004).

Techno-nationalism, on the other hand, is a protectionist ideology that aims for total national ownership and control over vital technology by way of restrictive regulations, subsidies, and obstacles to foreign participation (Lee et al., 2024). It is predicated on the idea that greater technology inevitably leads to economic and geopolitical domination. To keep technological developments inside national boundaries, the state follows a strategy which is mostly state-led and depends on trade restrictions, industrial subsidies, and nationalistic R&D strategies (Edler et al., 2016). Limiting foreign investment and international cooperation in an effort to stop technical leaks and preserve exclusive control over vital technology is a fundamental aspect of techno-nationalism (Capri, 2025). Instead of being a forum for mutual development and innovation, technological competition is viewed as a geopolitical battlefield under this strategy, which is founded on a zero-sum worldview (Mazzucato, 2015).

While such policies may bring short-term economic boosts, they often lead to long-term inefficiencies, greater technological redundancies, and limit access to global knowledge networks (Yavuz, 2024). Edler and Fagerberg (2017) states that countries which isolate themselves from global knowledge and international cooperation often face innovation stagnation, especially when their policies focus too much on self-sufficiency. To illustrate, in China, despite massive state investment under the “Made in China 2025” strategy, domestic semiconductor initiatives such as Tsinghua Unigroup failed due to limited global collaboration and critical technology gaps, leading to innovation bottlenecks and financial collapse (Capri, 2020). Furthermore, sectors may become less competitive globally if they rely too much on state-led initiatives, which may result in poor resource allocation and duplication of R&D efforts (Wagner and Popper, 2003). This approach was evident in Russia’s post-2014 import substitution program, which failed to produce competitive domestic alternatives to Western hardware and software due to limited access to international knowledge networks resulting inefficiencies in resource use (Connolly, 2020). Conversely, economies that strike a balance between global integration and national interests typically have more resilient industrial ecosystems, better levels of technological learning, and long-term economic resilience (Binz and Truffer, 2017). As explained above, Germany’s participation in Horizon Europe and its High-Tech Strategy 2025 enables it to build domestic R&D strength while benefiting from transnational research consortia, fostering deeper learning and long-term competitiveness.

Table 1
Technology Sovereignty vs. Techno-Nationalism

Aspect	Technology Sovereignty	Techno-Nationalism
Strategic Goal	Achieve autonomy while remaining interconnected	Achieve full self-sufficiency and control
Global Collaboration	Encourages partnerships with like-minded nations	Restricts foreign engagement to prevent technology outflow
Economic Efficiency	Focuses on comparative advantages and selective investments	Duplicates efforts, leading to wasteful spending
Innovation Approach	Supports open innovation and knowledge sharing	Prioritizes closed innovation systems
Policy Approach	Encourages public-private partnerships and R&D investments	Relies heavily on government subsidies and trade barriers
Impact on Competition	Increases global competitiveness through integration	Reduces competitiveness by limiting access to global expertise
Flexibility	Adaptive and responsive to changing global trends	Rigid and resistant to global market dynamics

Table 1 highlights the fundamental differences between Techno-Nationalism and Technology Sovereignty, two strategic frameworks increasingly used by states to guide technological development. Techno-nationalism is characterized by an inward-looking emphasis on self-sufficiency, national control of technology, and limited engagement with foreign actors. States employing this approach typically prioritize indigenous innovation, but may lack the collaborative infrastructure or global integration needed for rapid capability development.[2] In contrast, Technology Sovereignty adopts a more pragmatic stance: it recognizes global interdependence but seeks to secure strategic autonomy through strong domestic capacities, policy coherence, and selective integration with international partners (Edler et al., 2020). While both models are motivated by concerns over technological dependency, they differ in their operational logic, techno-nationalism

[2] See The Coming Tech Cold War With China https://www.foreignaffairs.com/articles/north-america/2020-09-09/coming-tech-cold-war-china, accessed: 11 March, 2025.

builds barriers, whereas technology sovereignty builds resilience. The difference between these two approaches becomes more evident when examining two real-world cases.

India's semiconductor policy in the early 2000s is a representation of a techno-nationalist approach. The government launched initiatives like the Modified Special Incentive Package Scheme (M-SIPS) to promote domestic semiconductor manufacturing by offering financial incentives. Despite these efforts, the lack of a comprehensive ecosystem, limited collaboration with global industry leaders, and bureaucratic challenges hindered progress. The focus on self-sufficiency without adequate integration into global supply chains resulted in unsatisfactory outcomes (Goldberg et al., 2024).[3]

In contrast, Germany’s approach to digital sovereignty, particularly in cloud infrastructure, illustrates technology sovereignty. The GAIA-X initiative is a European cloud federation launched in partnership with private industry and international collaborators, aims to ensure data sovereignty without isolating Germany or the EU from global platforms like Amazon or Microsoft (BMWK, 2021).[4] Rather than rejecting global players, Germany’s strategy focuses on regulatory control, interoperability, and strategic partnerships to build secure, sovereign infrastructure.[5]

2.1. Role of technological learning in technology sovereignty

Technological learning is a fundamental driver of industrial competitiveness, economic resilience, and innovation capacity in developing economies. It refers to the process through which firms, industries, and national innovation systems absorb, adapt, and advance technological knowledge, allowing them to catch up with technologically advanced nations (Bell and Pavitt, 1993). Without technological learning, efforts to establish sovereignty over key industries risk becoming hollow protectionism, where countries attempt to shield local industries without equipping them with the skills, knowledge, and infrastructure necessary for self-sustenance. Indeed, technology sovereignty is increasingly understood not merely as self-sufficiency, which can be detrimental (Montresor, 2001), but as the ability or competence of a state to identify, understand, develop, and use key technologies that impact its political and economic state (March and Schieferdecker, 2023). The state’s role extends beyond simply providing a regulatory framework; it more

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[3] See PIB Chennai https://www.pib.gov.in/PressReleasePage.aspx?PRID=1920586, accessed: 23 May, 2025.

[4] See Data Sovereignty in the European Cloud: The GAIA-X Model. https://www.tno.nl, accessed: 17 February, 2025.

[5] See *GAIA-X and Digital Sovereignty* https://www.bmwk.de, accessed: 4 April, 2025.

requires active science, technology and innovation policy that builds absorptive capacity.

Technological learning has long been recognized as the key enabler of industrial and technological progress, particularly in late-developing economies. Scholars define technological learning as a dynamic and multi-dimensional process that occurs through three main channels:

1. Learning by Doing – Practical experience in production leads to incremental improvements in efficiency and quality (Arrow, 1962).
2. Learning by Interacting – Knowledge-sharing between firms, research institutions, and policymakers fosters innovation (Lundvall, 2010). Research shows that interrelationships between actors (Montresor, 2001), public private partnerships and international cooperation in R&D (March and Schieferdecker, 2023) may help build technology sovereignty.
3. Learning by Adapting and Imitation – Nations import, modify, and improve foreign technologies, eventually developing indigenous capabilities (Kim, 1997). Research shows that states may learn even through technological spillovers and international trade (March and Schieferdecker, 2023) where such learning heavily rely on absorptive capacity (Szczygielski et al., 2025)

The evolutionary economics perspective argues that technological progress is path-dependent, meaning that a country's technological trajectory is shaped by historical learning processes (Nelson and Winter, 1982). This implies that technology sovereignty is not achieved overnight. It requires long-term accumulation of knowledge, infrastructure, and institutional capabilities. Countries that attempt to force technology sovereignty without first fostering learning mechanisms often face stagnation, inefficiencies, and reliance on outdated technologies (Freeman and Soete, 1997). Therefore, successful national technology strategies must prioritize learning mechanisms before implementing sovereignty measures. Merely focusing on protectionism or regulation is insufficient; achieving technology sovereignty requires active participation in technological development through research and innovation supported by the state (March and Schieferdecker, 2023).

Technological spillovers of multinational establishments are one of the most important external channels of learning, which improves the nation's technological knowledge and adapt in a globally connected innovation system (Ernst and Kim, 2002). Technological spillovers include two sides: one side -a firm, a sector, or a nation- generates knowledge, while the other benefits without any transactions (Seo and Won Sonn, 2019). There are different forms of channels of spillovers such as foreign direct investment (FDI), global supply chains, multi-national R&D, and the relocation of skilled worker mobility (Lai et al., 2006). The more a country is connected with international networks of production, the more the chances to absorb external knowledge and transform it into innovation. However, such learning does not happen automatically, as Romer (1990) describes. It depends on the absorptive capacity of the nation's institutional readiness, skilled labor, and policy incentives that allow knowledge exchange (Lall, 2001). Thus, technology sovereignty necessitates not only the protection of key industries but creating mechanisms for internalizing global flows of knowledge. China's industrial advancement is a good example. China has substantially widened its technological base through several decades of strategic imitation and adaptive learning, especially in the fields of the telecom and electronics industry and the high-speed rail (Fu and Gong, 2011). At an early stage, Chinese enterprises were integrated into international value chains as a low-cost producer reverse engineering foreign technology. With the help of focused industrial policy, heavy state guidance, and huge R&D investment these companies ultimately achieved the ability to innovate on their own (König, et al., 2021). China's case shows how learning by imitation can become the first step toward catching up when it is supported by well-intentioned institutional support and long-term planning. Another example in terms of how technology spillover helped technological learning is South Korea. The strategic integration of FDI in the 1980s and 1990s and setting companies like Samsung and LG Electronics placed South Korea among the high-tech centers of today (Kim, 1997). These companies initially bound on foreign partners, especially U.S. and Japanese multinational corporations for technology license, equipment, and experience. Through early technology transfer agreements, Korean companies were able to penetrate into global value chains in semiconductors and consumer electronics. Through active learning by doing, reverse engineering, and R&D activities, these companies finally reduced their dependence on external technologies by internalizing foreign knowledge. Thus, companies consolidate their new technological capability by organizational learning and innovation (Lee, 2002). This FDI-enabled learning cycle brought about Korea's transition from being a mere importer of technology to being a global leader in electronics innovation.

A country's capacity to develop, adapt, and use technological knowledge, which calls for a strong base in human capital, institutional infrastructure, global connection, and flexible policies, is a key component of technology sovereignty (Montresor, 2001). Since countries without specialized knowledge in vital areas find it difficult to convert research into useful applications, a highly qualified workforce is crucial for promoting technological advancement, innovation, and industrial competitiveness (Mazzucato, 2015; Blind, 2025; da Ponte et al., 2022). Strong research institutions, innovation hubs, and technology transfer systems are equally crucial since they form the foundation of the country's knowledge infrastructure and facilitate the smooth transfer of scientific and technological developments across sectors (Freeman, 1995). These are elements of internal capabilities which are key to build technology sovereignty (da Ponte et al., 2022; Szczygielski et al., 2025).

Achieving technology sovereignty, however, does not entail excluding itself from international developments; rather, strategic openness to foreign knowledge, partnerships, and agreements for knowledge-sharing greatly speeds up learning and enables countries to incorporate outside innovations into their own industries (Lall, 2001). Furthermore, government policies must be flexible and responsive to technological developments. This way, industrial strategies can align with new global trends instead of being restricted by strict nationalization laws that could impede innovation (Lee et al., 2024). In an increasingly knowledge-driven economy, countries can maintain their global competitiveness while achieving self-reliance in key technologies by cultivating these interrelated components.

3. Research method

3.1.The context

The medical device industry has become a vital component of economic and healthcare development in almost all economies, including Brazil and Türkiye, where public health reforms and demographic change accelerate demand for advanced diagnostic technologies. Both countries have invested significantly in expanding healthcare infrastructure, with magnetic resonance imaging (MRI) technology emerging as a key area of innovation and state intervention. MRI technology was selected as the focal point of the study due to its high degree of technical complexity and strategic importance within national health systems. The MRI sector exemplifies the challenges faced by emerging economies in acquiring, producing, and adapting frontier technologies.

The MRI industry is very specialized and controlled by large international companies, which makes it hard for smaller or newer players to enter (Geethanath and Vaughan, 2019). Both Brazil and Türkiye have pursued state-led interventions to support MRI manufacturing, but with differing degrees of policy orientation, making them ideal for comparative inquiry. Türkiye’s government focused on nationalizing MRI production, but the project did not succeed. In contrast, Brazil supported the industry by encouraging foreign direct investment. This shows a key difference: Brazil followed a "localization" strategy, while Türkiye chose "nationalization."

Brazil hosts Latin America's largest medical device market, supported by its Unified Health System (SUS), one of the world's largest public healthcare programs. As of 2022, Brazil had the highest MRI scanner density in the region, with 14.52 units per million inhabitants, and the market is projected to grow to USD 393.06 million by 2028, driven by increasing demand and ongoing technological advancement (Viana et al., 2024).[6] Despite its historical economic volatility, Brazil has successfully attracted foreign direct investment (FDI) and developed a regulatory framework that supports both public and private innovation (Viana et al., 2016).

In contrast, Türkiye, with a population of over 85 million, has pursued a more nationalized model, focusing on domestic production and import substitution in medical technologies. The Health Transformation Program launched in 2003 significantly increased public access to MRI diagnostics, raising the number of MRI scanners from 58 in 2002 to 1,477 in 2018 (Geethanath and Vaughan, 2019). However, the Turkish market remains import-dependent, with multinational firms controlling around 80% of the sector (Aslan et al., 2014), and the domestic industry facing challenges in technological capacity, production scale, and global competitiveness (Kiper, 2013). Recent policy tools such as the Strategic Investment Incentive Scheme and Domestic Product Priority Initiative reflect state efforts to reverse this trend.[7]

The comparison between Brazil and Türkiye offers a unique lens for examining how different state strategies shape technological learning in emerging economies. Both countries share similar macroeconomic profiles, including large populations, upper-middle-income status, and a history of state-led industrial policies, yet they have pursued distinct pathways in high-tech sectors such as MRI manufacturing. Brazil's approach, rooted in localization and global integration (which can be associated with technology sovereignty) contrasts sharply with Türkiye's emphasis on nationalization and import substitution (that can be associated with techno-nationalism). This divergence presents a rare opportunity to analyze how policy design and government role impact innovation outcomes in structurally comparable settings.

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[6] See *Brazil MRI Market - Growth, Trends, Forecast (2023–2028),* https://www.mordorintelligence.com, accessed: 12 July, 2024.

[7] See Why Invest in Turkish Medical Technologies Industry, https://www.invest.gov.tr/en/library/publications/lists/investpublications/medical-technologies-industry.pdf, accessed: 05 March, 2025.

3.2.Research design and data

This study employed a qualitative inductive methodology to investigate how the state induces technological learning mechanisms in the production of high-tech medical devices within emerging economies.

The rationale for choosing this approach is that it allows for a comprehensive understanding of the complex and multifaceted phenomenon of technological learning and the state's role in this process (Vergara et al., 2023).

The research design integrates multiple stages, including a comprehensive literature review, targeted participant selection, data collection through semi-structured interviews, and detailed qualitative data analysis. Each stage is carefully structured to provide an in-depth understanding of the role of state policies and market dynamics in shaping the MRI technologies/industries of these two countries.

The data collected utilized semi-structured interviews with key stakeholders in the MRI industry in Brazil and Türkiye. Interviews were designed to explore participant perspectives on the following areas:

- Technological learning processes (internal and external),
- State involvement in production and R&D,
- Market dynamics, and
- Regulatory and institutional frameworks.

Interviews were conducted between March 15 and August 12, 2024, lasting between 30 and 90 minutes, and were held in Turkish for Türkiye and English for Brazil. Participants included industry experts, engineers, policymakers, and business leaders, selected via purposive sampling to ensure sectoral relevance and knowledge depth (Palinkas et al., 2015). Table 2 presents information on the interviewees. The sample is diverse in terms of the role of the interviewee and where they work (business, government, academia). Nineteen participants were interviewed across both countries. Recruitment was done through LinkedIn and professional email outreach. The snowball sampling method was adopted, with ethical approval obtained from the Middle East Technical University Ethics Committee. All participants provided informed consent, and interview data were anonymized and transcribed verbatim for accuracy and confidentiality.

The interview data were analyzed using thematic analysis, following the six-step model by Khokhar et al. (2020):

1. Familiarization with transcripts through repeated reading,
2. Initial coding of significant features linked to the research questions,
3. Theme identification by clustering related codes,

4. Theme review to ensure coherence and clarity,
5. Theme definition and labeling, and
6. Integration into the analytical narrative.

Data coding and analysis were conducted using MAXQDA, with an initial codebook developed from the literature review and interview guide. The process was iterative, allowing for refinement of codes and emergence of new themes as the analysis progressed. Triangulation between interview data, literature, and policy documents helped ensure analytical depth and credibility.

Recurring themes included the role of the state as an enabler or constraint, institutional learning, supply chain limitations, FDI and knowledge transfer, and the contrast between policy continuity and fragmentation in both countries.

The study followed strict ethical guidelines, and although it offers rich insights, it also acknowledges limitations. The findings, while grounded in empirical evidence, are context-specific and may not be generalizable to all developing countries. Furthermore, language barriers may have influenced the depth of data in bilingual interviews.

Table 2
Participant Demographics

Nick	Role	Institution / Organization	Country
INT1	MRI Field Engineer	Global MRI Manufacturer Firm	Türkiye
INT2	Project Coordinator	Local Private Firm	Türkiye
INT3	Health Techology Director	Local Private Firm	Türkiye
INT4	MRI Field Engineer	Local Private Firm	Brazil
INT5	MRI Field Engineer	Global MRI Manufacturer Firm	Brazil
INT6	Head of strategy development department	Policymaker	Türkiye
INT7	MRI technician	Global MRI Manufacturer Firm	Brazil
INT8	Professor, Electrics & Electronics Engineering Dept.	University Research Center	Türkiye
INT9	Board member	Sectoral association	Türkiye
INT10	Head of R&D projects	Policymaker	Türkiye
INT11	Chair of the Board	Union	Türkiye
INT12	Product Manager	Local Private Firm	Türkiye
INT13	Business Manager	Global MRI Manufacturer Firm	Brazil
INT14	Professor, Electrics & Electronics Engineering Dept.	University	Türkiye
INT15	Professor, Economics	University	Brazil
INT16	Manager	Government Bank	Brazil
INT17	Technical Specialist	Global MRI Manufacturer Firm	Brazil
INT18	Professor, Economics	University	Brazil
INT19	Electronics Engineer	Local Private Firm	Türkiye

4. Comparative analysis: The role of the state in technological learning in MRI production

Technological learning is a fundamental driver of industrial competitiveness, economic resilience, and innovation capacity, particularly in developing economies. It refers to the process through which firms, industries, and national innovation systems absorb, adapt, and advance technological knowledge, allowing them to catch up with technologically advanced nations (Bell and Pavitt, 1993).

The cases of Türkiye and Brazil in MRI manufacturing provide a real-world comparison of how different national strategies impact technological learning and technological sovereignty. While both countries aimed to develop domestic MRI production, their approaches diverged significantly. Türkiye pursued a techno-nationalist nationalization strategy, while Brazil adopted a technology sovereignty-focused localization strategy. Our analysis shows that differing policy choices led to starkly different outcomes in knowledge absorption, industrial competitiveness, and long-term technological independence (Yavuz, 2024).

4.1.The case of Türkiye: The pitfalls of techno-nationalism

Türkiye's MRI production efforts were part of a broader strategy of "nationalization" under the country's industrial policy. The state initially played an active role as a priority setter, identifying MRI technology as a key sector within the 10th Development Plan and the National Technology Initiative (Strateji Bütçe Başkanlığı, 2014). The goal was to reduce foreign dependency in medical imaging and create domestic production capabilities.

> *INT3: Using a Prime Ministry circular, a steering group for the health industry was formed in 2015. In brief, we call it TÜSEB. The undersecretaries of the Ministry of Health, the undersecretaries of all pertinent ministries, the committee chairman, and TITCK's committee secretariat were present when the committee was established. The goal of this committee was to localize the Turkish health industry. To accomplish this, several meetings were held, and choices made during these meetings were used to try and implement the MR project.* Author's note for the reference mentioned: Official Gazette (2014).

As Interviewee 3 mentioned, the prioritized sectors were specified in the "Health Industries Structural Transformation Program Action Plan" published by the Ministry of Health. Approving the participant's statements, in the Turkish Medical Device Sector Strategy Document published in 2015, it was stated that the

Tenth Development Plan, prepared in line with Türkiye's 2023 goals and covering the period 2014-2018, was prepared to include elements such as high, stable and inclusive economic growth as well as international competitive power, advanced manpower and sustainable use of resources (Strateji Bütçe Başkanlığı, 2014).

A notable initiative was the Aselsan-UMRAM MRI project, a collaboration between the defense contractor Aselsan and Bilkent University’s National Magnetic Resonance Research Center (UMRAM). This partnership was designed to leverage domestic R&D capabilities and create an indigenous MRI system.

> *INT19: Regarding the tasks that needed to be done, there were explicit work packages. Aselsan was striving to learn as much as possible about the product at the system engineering level while UMRAM was providing technical and academic knowledge.*

In alignment with the aforementioned goal, the MRI project was initiated through a collaboration between Aselsan and Bilkent University UMRAM laboratory. The subsequent sections provide a detailed overview of the developmental stages of this project, along with the experiences and insights gained throughout these phases.

> *INT12: I am not sure about the reasons behind it, but the decision was made not to continue the project.*

The project continued actively between 2015-2021. News appeared in the press in 2021 stating that the Magnetic Resonance Imaging studies by Aselsan are ongoing to enter the market first with full-body 1.5T MR imaging device models. After this statement, no further updates were found, and all participants confirmed that the project had been closed.

When asked about the reasons, different participant groups provided varying explanations. Understanding why the project ended is important for evaluating the limits of the policy framework. It was noted that the research was funded by TÜBİTAK, and teams from Aselsan and UMRAM stated they were able to continue their work during the funded period.

> *INT14: In the end, Aselsan is business focused on making money. It doesn't believe that producing MRI devices will help it become more competitive in the market.*

INT12: As I said, we can't continue without a strategic decision for products that have a very high market penetration and very high development costs.

The necessary system engineering work for the MRI project was completed. However, further steps, such as clinical validation, were still needed and were considered too costly. They expected a clearer commitment from the state to continue the project, but this support did not materialize. As a result, the project was paused. Since Aselsan does not intend to enter the medical device market and sees limited commercial profit from MRI equipment, the company chose not to invest its resources to move the project forward.

INT10: Regarding the MRI aspect, development is currently in progress. Therefore, even though nothing has been generated thus far, the motivation is still very much present.

INT6: Technology is like a train, you see the locomotive first. You see, the last wagon, when you see the last wagon, you have no chance of getting on that train. If you want to get on that train, you have to notice it from afar and wait where it will stop. Many trends in technology pass us by in this way. Just like internal combustion engine technology. Therefore, I am saying that the train passes for all medical devices that cannot be developed in Türkiye, including MRI.

Another interesting finding is about the lack of awareness of the project. Some interviewees expressed skepticism about the suitability of investing in MRI technology, suggesting that resources should instead be directed toward emerging fields such as artificial intelligence. When TÜSEB was asked about the project's termination, it became clear that they were unaware of the initiative, indicating a lack of coordination within the Ministry of Health. Similarly, UMRAM reported that the project ended due to insufficient funding and a failure to establish effective collaboration among stakeholders, highlighting systemic barriers to sustaining high-tech innovation efforts. The disagreement and sometimes contradicting statements of the three actors involved in the project is a showcase about lack of coordination -a systemic problem that could have been addressed by the state.

INT2: We stopped these studies after determining that we could not proceed with this investment without at least the state's assured purchasing support. Such a project needs significant guaranteed purchase incentives in order to proceed.

A key insight from the interviews is that the lack of guaranteed purchasing support from the government was a major barrier to advancing MRI production. As emphasized by one participant, large-scale, high-risk projects like MRI manufacturing require assured demand to justify investment. Without such state-backed commitments, firms are reluctant to proceed. Instruments such as purchase guarantees, subsidies, low-interest loans, and tax incentives are essential to lower the financial risks associated with R&D and production. Additionally, clear and supportive regulations are necessary to ease entry into high-tech sectors. Although a public hospital tender was announced for this project, its stringent requirements made it inaccessible, further limiting the project's potential for realization.

To summarize, despite significant progress, the project stalled due to several factors:

1. Lack of Government Commitment Beyond Initial Investment – While initial funding was available through The Scientific and Technological Research Council of Türkiye (TÜBİTAK), there was no long-term financial commitment from the state. The absence of a government-backed purchasing guarantee made the project commercially unviable, deterring private sector involvement. Continued and sustainable funding mechanisms are important in running such high-cost high-tech projects. There are numerous cases in China and South Korea that support this claim. While such countries have learned from their mistakes, the policy learning mechanisms in Türkiye specific to MRI production were mostly absent.
2. Limited Integration with Global Knowledge Networks – Türkiye's approach emphasized self-sufficiency, prioritizing domestic R&D over partnerships with foreign technology firms. However, MRI manufacturing requires highly specialized knowledge and limited access to global expertise slowed down progress. This partially illustrates the "strategy-gap" in establishing high-tech sectors in emerging countries. It also directly addresses the lack of learning by adapting and imitating.
3. Institutional Gaps and Bureaucratic Inefficiencies – Unlike Brazil's structured approach, Türkiye lacked a clear institutional framework to support coordination between research institutions, industry, and government agencies. The fragmented approach led to inefficiencies, with critical knowledge being confined within research labs rather than translated into industrial applications. This is a systemic problem. Though the state initiated certain capabilities within each actor involved, the interaction between actors was limited. This finding shows that learning by interacting mechanisms also did not work in the case of Türkiye.

4. Failure to Scale Beyond the Prototype Stage – A prototype was successfully developed, but the lack of a commercialization strategy and sustained financial support prevented large-scale production. This again illustrates the strategy-gap as mentioned above.

Ultimately, Türkiye's nationalistic approach failed to establish a viable domestic MRI production industry. The project was discontinued, reinforcing the challenges of achieving technology sovereignty without a well-integrated technological learning strategy. The nationalistic top-down policy prevented technological learning mechanisms from forming.

4.2.The case of Brazil: A case of strategic localization

Brazil's initial efforts to foster domestic production of advanced medical technologies—such as MRI, took shape in the early 2010s with the introduction of the Local Content Policy (LCP). This industrial policy framework aimed to reduce technological dependence and develop local capabilities by integrating financial incentives, public-private partnerships, and technology transfer mechanisms. The LCP was designed not only to support manufacturers but also to stimulate demand, by offering financing support to end-users such as hospitals.

A major turning point came in 2012, when MRI systems were added to the SUS (Sistema Único de Saúde) Priority Products List (Government of Brasil, 2012) through a government circular. This designation unlocked eligibility for multiple policy tools under the LCP framework, prompting multinational companies—including Siemens, GE, and Philips—to establish MRI manufacturing facilities in Brazil.

> *INT 5: When we look at the big players coming to Brazil and opening MRI factories, you see the years between 2010 and 2014. The reason for this is the success of the local content policy implemented to attract foreign players to the country.*

In this context, localization was defined not by ownership of capital but by geographic production within Brazil. As INT18 emphasized:

> *INT 18: From the standpoint of international trade, local and, as far as Brazilian policy is concerned, distinct entities, we are unable to distinguish between companies based solely on the ownership of their capital; instead, we can compel them to engage in particular activities*

domestically, which is why we refer to this as local content rather than national content.

This approach enabled international companies to benefit from incentives while meeting the condition of local production.

Further institutionalization occurred through the Interministerial Ordinance MDIC/MCT No. 28 (Government of Brasil, 2012), which specified the minimum requirements for MRI systems to qualify under the LCP. The regulation emphasized technological alignment with national health priorities and the importance of collaboration between government, academia, and industry in developing a sustainable manufacturing base which was important for learning by interacting within the MRI ecosystem.

In parallel, Brazil employed Productive Development Partnerships (PDPs) as a complementary strategy. These long-term agreements between the Ministry of Health, private companies, and public laboratories aimed to ensure technology transfer and domestic capacity building. Over a typical ten-year term, the Ministry of Health committed to procure the product for SUS, while the private partner agreed to transfer production knowledge and capabilities to a public entity. Thus, there was a long-term coordinated strategy of developing MRI technology that works through the local content policy.

INT 16: The local content policy implemented by the Brazilian government provided incentives for multinational companies like Siemens, Philips, and GE to manufacture MRI equipment within the country. These companies began producing MRI systems in Brazil to take advantage of the policy, which included financing mechanisms through BNDES to help hospitals and healthcare providers purchase the domestically manufactured equipment.

This dual strategy, incentivizing both production and consumption, proved highly effective. Hospitals were granted access to low-interest loans through the Brazilian Development Bank (BNDES), while manufacturers benefited from guaranteed demand, facilitating a brief but impactful period of industrial growth in the MRI sector. Such coordination between different actors in the government and the state orchestrating the interaction was mostly absent in the Turkish case.

Despite these early successes, the domestic MRI production initiative suffered a critical setback following administrative changes in 2017. Key support mechanisms were dismantled:

- MRI systems were removed from the SUS Priority Products List (Portaria No. 704/2017)
- Low-interest loans through BNDES were discontinued
- No new policy incentives were introduced to sustain momentum in the MRI sector

These changes severely weakened Brazil's local MRI manufacturing capacity. The sector experienced stagnation, and most of the facilities established under the earlier policy environment ceased operations. According to INT16, only one facility remains operational today, illustrating the fragility of policy-driven industrial development when incentives are not maintained.

Although no targeted policy currently supports MRI manufacturing, the Health Economic-Industrial Complex (HEIC) framework has emerged as Brazil's most ambitious effort to integrate health, industrial, and innovation policies. First introduced in the late 2000s and recently revived under Decree No. 11,464/2023, the HEIC provides a strategic basis for revitalizing local production of health-related technologies, especially in response to crises such as COVID-19.

HEIC seeks to:

- Coordinate industrial and scientific agendas
- Reduce dependency on global suppliers
- Promote universal health access through domestic innovation

The Executive Group for the Health Economic-Industrial Complex plays a central role in facilitating inter-agency collaboration and aligning national R&D and production goals with the needs of the Unified Health System (SUS). Under this framework, the Ministry of Health aims to achieve 70% local production of essential health goods and services by 2027.

Currently, the HEIC policy scope includes:

- Medicines, vaccines, APIs, and blood products
- Biotechnology and diagnostic products
- Medical equipment and personal protective materials
- Digital health technologies and connectivity tools
- Strategic goods and services for public health delivery

Although MRI technology is not currently listed among the strategic products eligible for support, experts note that should MRI be reclassified as a national priority, existing HEIC instruments could be activated. These include demand side designs such as public procurement, and various supply-side designs including technology transfer agreements, and credit mechanisms, all of which proved effective during the earlier LCP phase. Brazil's successful application of HEIC in vaccine production during the COVID-19 pandemic illustrates the framework's potential. It demonstrates that with political will and institutional continuity, Brazil can mobilize public policy to restore domestic capabilities in high-tech medical fields like MRI.

The period between 2010 and 2014 showed how a coordinated mix of financial incentives, public procurement, and partnership mechanisms can rapidly scale domestic manufacturing and attract global players. However, the 2017 policy reversal exposed the limitations of time-bound or politically contingent policies. Without sustained state support, domestic industries can falter. Looking forward, the revived Health Economic-Industrial Complex provides a promising platform to reconsider MRI technology as a strategic product. The tools exist—what remains is the policy prioritization.

Following four points summarizes Brazil's approach:

1. State-Led Incentive Structures: Brazil introduced the Local Content Policy (LCP) and Productive Development Partnerships (PDPs) to attract multinational MRI manufacturers. These policies encouraged foreign firms to set up local production facilities while partnering with Brazilian institutions for knowledge transfer. This is an indication that there was a learning by doing strategy partially based on adoption and partially on spillovers.
2. Integration into Global Value Chains: Unlike Türkiye, which sought full domestic development, Brazil strategically collaborated with international firms to acquire expertise. This allowed local firms to learn from foreign partners while gradually increasing indigenous production capabilities. This is an indication of the presence of learning by interacting.
3. Government-Backed Procurement Mechanisms: One of Brazil's most effective policies was the inclusion of MRI devices in the Unified Health System's (SUS) priority list. This meant that hospitals purchasing MRI machines were incentivized to buy domestically produced models, ensuring a steady demand for locally manufactured units.
4. Sustained Financial Support for Innovation: The Brazilian Development Bank (BNDES) provided low-interest loans to MRI manufacturers and hospitals, reducing financial barriers for domestic production. This support was crucial in sustaining industrial learning and encouraging long-term investment.

4.3.Comparison

A comparison of Türkiye and Brazil reveals important insights into how state capacity, policy design, and institutional coordination shape technological learning and domestic production in high-tech sectors such as MRI. As summarized in Table 3, the two countries followed markedly different trajectories despite facing similar challenges related to import dependency and access to advanced medical technologies.

Türkiye’s approach aligns more with techno-nationalist framework, characterized by a focus on indigenous capability development and self-sufficiency, yet ultimately constrained by limited integration with global networks and fragmented institutional support. Brazil, on the other hand, pursued a model rooted in technology sovereignty, emphasizing strong state intervention, international collaboration, and sustained policy instruments that aimed to embed foreign capabilities into the domestic production system. This divergence offers a valuable lens for understanding the institutional and political economy conditions that enable technological upgrading.

Table 3

Comparison of Türkiye’s and Brazil’s Approach.

Factor	Türkiye (Techno-nationalist Approach)	Brazil (Technology Sovereignty Approach)
State Role (learning by doing strategy)	Priority setter, but lacked sustained commitment	Strong state intervention with consistent supply-side and demand-side supports
Institutional Collaboration (learning by interacting)	Weak coordination between academia, industry, and government	Well-structured institutional frameworks (PDPs, LCP) that permit and even force interaction
Integration with Global Networks (learning by interacting)	Limited, focused on self-sufficiency	Strong collaboration with foreign firms
Financial Incentives (learning by doing strategy)	Initial R&D funding, but no long-term investment	Government-backed demand through SUS priority list, Low-interest loans, direct procurement incentives

In Türkiye, the pursuit of MRI production was shaped by a techno-nationalist development narrative, wherein the state positioned itself primarily as a priority setter, articulating strategic objectives without establishing a sustained policy infrastructure. Although public institutions initiated feasibility assessments and preliminary R&D efforts, these were not embedded in a broader ecosystem of policy instruments or institutional collaboration. The project lacked both a long-term budgetary commitment and effective coordination between government bodies, resulting in fragmented implementation and eventual abandonment. Efforts to localize production remained largely inward-looking, with limited engagement in international partnerships that could have facilitated technology transfer or accelerated capability building. All of these indicate limited or even absent learning by interacting mechanisms. Moreover, the absence of guaranteed demand mechanisms, such as advance purchase commitments or integration into the public procurement system, created a high-risk environment for private sector participation. The policy framework was very limited indicating that the learning by doing mechanisms were not planned and assumed automatic. Consequently, Türkiye was unable to convert strategic intent into industrial output, and the MRI production initiative stalled without establishing domestic manufacturing capacity.

In Brazil, by contrast, the state assumed a more strategic interventionist role, embedding MRI production within a broader framework of technology sovereignty and industrial health policy. The findings show how Brazil’s Local Content Policy (LCP) and the inclusion of MRI in the SUS Priority Products List during the early 2010s catalyzed significant foreign investment, leading multinational firms such as Siemens, Philips, and GE to establish production facilities within Brazil. This policy was further supported by structured public-private mechanisms, including the Productive Development Partnerships (PDPs), which aligned industrial objectives with the public health needs of SUS. This shows that even the learning by interacting mechanisms were planned beforehand. The LCP framework emphasized localization of activities over national ownership, allowing international companies to participate so long as production occurred domestically, thus balancing global integration with sovereign technological capability building goals. Furthermore, financial instruments offered through BNDES, such as low-interest loans to hospitals, created demand-side incentives that simultaneously stimulated local production and expanded healthcare access. Although Brazil’s momentum was disrupted by administrative changes in 2017, which led to the removal of MRI from the strategic product list and the rollback of credit policies, the findings show that the country had achieved a period of successful technological learning and ecosystem development, illustrating the potential of coherent, state-led policy coordination to drive industrial outcomes in complex health technologies.

5. Conclusion

This study explores the link between technology sovereignty and techno-nationalism by analyzing how state strategies affect technological learning in two emerging economies, with a focus on MRI technology. While both Türkiye and Brazil share similar macroeconomic profiles and goals of reducing technological dependency, they adopted contrasting approaches: Türkiye opted for building technological capabilities through nationalization (yerli-milli) and Brazil through strategic localization and international collaboration. By comparing these cases, the study highlights that technology sovereignty is more effective when rooted in flexible policy design, global integration, and institutional coordination than rigid techno-nationalist frameworks especially where state capacity is weak. Although both nations tend to lessen their reliance on foreign MRI producers, Brazil's cooperative approach produced real technology advancements and production success. Without adequate institutional and market support, and also sustainable state support, Türkiye's nationalization bid to gain sovereignty finally failed.

The literature sees techno-nationalism and technology sovereignty as two separate and opposing strategies. Lee et al. (2024) describe techno-nationalism as a strict, inward-looking approach focused on full national control, which can often reduce innovation efficiency. In contrast, they describe technology sovereignty as a more flexible and cooperative model that allows for strategic collaboration with trusted international partners. Similarly, Crespi and Edler (2021) warn that techno-nationalist policies can isolate national innovation systems and block knowledge exchange. At the same time, Edler and Fagerberg (2017) remind us that innovation policy must support not only research but also institutions, infrastructure, and market development, especially in countries with limited capacity. While achieving technology sovereignty depends on maintaining connections to global innovation networks, building technological capabilities often requires selective protection, strong state coordination, and focused industrial policies, key features of techno-nationalist strategies. The Turkish late industrial development motto "indigenous-national" has elements of both technology sovereignty and techno-nationalism but our results show that nationalistic elements were more emphasized than indigenous production elements which lead to the failure of Turkish strategy.

While this study has explored the contrasting strategies of technology sovereignty and techno-nationalism through the cases of Brazil and Türkiye, it does not endorse a single model. Instead, the findings reveal the strengths and limitations of each approach when applied in isolation. Türkiye's state-led nationalization effort struggled without sustained institutional alignment, while Brazil's localization strategy succeeded only with consistent international partnerships and investment support. These outcomes raise an important question for future research: What if emerging economies were to adopt a carefully designed hybrid model, one that combines the protective coordination of techno-nationalism with the global openness of technology sovereignty? Could such a strategy unlock greater technological learning, industrial capacity, and innovation resilience? By posing this question, this study aims to rethink policy frameworks in the Global South toward more flexible, adaptive, and context-driven models for achieving technological autonomy in an interdependent world. Our study shows that while Türkiye's "indigenous-national" strategy may reflect a hybrid model, its actual application in the production of MRI technology capabilities was mostly nationalistic. This may also indicate the difficulty of establishing and applying hybrid strategies that aim to gain technological autonomy.

But we still argue that the most feasible route to technology sovereignty is a balanced strategy in which a country maintains control over critical technology assets while building strategic alliances. In today's integrated global economy, the idea that a nation may attain total technological independence is not only unachievable but also detrimental. Rather, a policy framework that combines strategic international cooperation with domestic capacity-building is the most effective way to promote technological learning and industrial competitiveness. This study shows that this is not easy to achieve.

The necessity of consistent financial backing for high-tech enterprises is one of the most important lessons learned from the MRI manufacturing in Brazil and Türkiye. Even the most ambitious programs run the risk of stagnating without long-term investment beyond the research phase, as evidenced by Türkiye's difficulties growing its MRI manufacturing efforts. Likewise, strategic international alliances need to be viewed as a force for sovereignty rather than a threat to it. While countries that strategically interact with global technology leaders gain from knowledge spillovers and greater domestic capability building, overemphasizing self-sufficiency frequently results in technological stagnation.

Another critical component of effective sovereignty strategies is institutional coordination between government bodies, industry, and academia which could be tied to the literature on the importance of government capacity in pursuing industrial policy. The absence of structured knowledge transfer mechanisms can confine innovation within research institutions, preventing its translation into tangible economic and industrial value. Establishing strong, well-integrated innovation ecosystems ensures that state policies are not merely theoretical but lead to concrete technological advancements.

Furthermore, creating domestic demand for high-tech products through procurement incentives plays a decisive role in sustaining technology sovereignty. Even with robust R&D efforts, a lack of local market demand can hinder large-scale production and innovation diffusion. Brazil's approach to securing domestic demand for its MRI machines demonstrated the effectiveness of government-backed procurement strategies in supporting local industry development.

In high-tech sectors, sovereignty is not about isolation, but about navigating interdependence with a strategic vision that enhances both national resilience and international competitiveness. Long-term industrial leadership depends on openness to knowledge flows, paired with domestic policies that build core capacities and secure critical technologies. As global competition for technological leadership intensifies, the pursuit of sovereignty is no longer a theoretical ambition it has become a strategic necessity. This study suggests that the most effective path forward lies not at one ideological extreme, but in the adaptive combination of protection and cooperation, tailored to the unique context of each nation.

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Özet

Tekno-milliyetçilik mi teknoloji egemenliği mi? Türkiye ve Brezilya'da MR teknolojisi geliştirme faaliyetlerinden karşılaştırmalı bulgular

Bu makale, tekno-milliyetçilik ve teknoloji egemenliği stratejilerinin teknolojik öğrenme ve yerli üretim kabiliyetlerini, özellikle de MR teknolojisinin geliştirilmesini nasıl etkilediğini inceleyerek Türkiye ve Brezilya'yı ekonomi-politik çerçevede karşılaştırmaktadır. Teknolojik ilerlemeler ve jeopolitik değişimler, devletleri teknolojik özerklik, tedarik zinciri esnekliği ve ulusal güvenliği vurgulayan sanayi politikalarını yeniden gözden geçirmeye itmiştir. Türkiye'nin "yerli-milli" yaklaşımı, teknolojik öğrenmeyi engelleyen güçlü tekno-milliyetçi eğilimler sergilerken, Brezilya'nın daha açık, işbirliğine dayalı stratejisi teknoloji transferini kolaylaştırmış ve yerli üretim yeteneklerini önemli ölçüde geliştirmiştir. MR teknolojisi, karmaşıklığı, sağlık hizmetleri açısından stratejik önemi ve çok uluslu şirketlerin hakim olduğu yoğunlaşmış küresel pazar nedeniyle ideal bir inceleme sahası sunmaktadır. Bulgular, Türkiye'nin sınırlı kurumsal uyum ve sınırlı küresel entegrasyon ile açıklayabileceğimiz tekno-milliyetçi stratejisinin teknolojik kabiliyet inşasını kısıtladığını ortaya koymaktadır. Buna karşılık, Brezilya'nın yapılandırılmış politika müdahaleleri ve uluslararası işbirliği ile desteklenen üretimin yerelleşmesi politikası, teknolojik öğrenme ile sonuçlanmıştır. Bu araştırma, literatürde karşılaştırmalı olarak nadiren incelenmiş bir alan olan Türkiye'nin hibrit teknoloji geliştirme stratejisini (yerli-milli) inceleyerek yeni içgörüler sunmakta ve böylece gelişmekte olan ekonomilerde teknoloji egemenliği ve tekno-milliyetçilik tartışmalarını zenginleştirmektedir.

Anahtar kelimeler: Tekno-milliyetçilik, teknoloji egemenliği, Türkiye, Brezilya, MRI

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