REMUNOM
ISSN 2178-6925

Received: 13/01/2026 - **Accepted:** 03/05/2026
Vol: 13.08
DOI: 10.66104/p32n8w07
Pages: 1-18

BRIDGING THE BRAIN DRAIN: REPATRIATION POLICY AND THE ENHANCEMENT OF ABSORPTIVE CAPACITY FOR TECHNOLOGY TRANSFER IN BRAZIL

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Abstract

This study examines the potential role of repatriating qualified personnel in strengthening the absorptive capacity of Brazilian organizations and its implications for technology transfer. Addressing the "brain drain" phenomenon, the research analyzes the Brazilian "Conhecimento Brasil" program through a qualitative, exploratory approach based on a structured literature review. The analysis draws on established frameworks on absorptive capacity and innovation systems to examine how returning researchers may influence organizational capabilities. Repatriated professionals are interpreted as potential boundary spanners and gatekeepers, facilitating knowledge circulation between Science and Technology Institutions and firms. Their presence may support learning processes, strengthen internal Research and Development structures, and improve the conditions for technology transfer. However, the study identifies limitations in the current policy design, including weak incentives for entrepreneurship and limited mechanisms to engage firms. These constraints may reduce the broader impact of repatriation initiatives. The findings suggest that repatriation policies may represent a relevant strategy when combined with

REMUNOM
ISSN 2178-6925

Received: 13/01/2026 - **Accepted:** 03/05/2026
Vol: 13.08
DOI: 10.66104/p32n8w07
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measures that strengthen organizational capabilities. The study contributes by linking human capital mobility, absorptive capacity, and technology transfer, offering a theoretical perspective for innovation policy in emerging economies.

Keywords: Absorptive Capacity; Technology Transfer; Brain Drain.

1. Introduction

In recent decades, Brazil has experienced a persistent emigration of highly qualified researchers and professionals seeking improved working conditions, scientific infrastructure, and opportunities for innovation abroad. This phenomenon, known as "brain drain," refers to the emigration of skilled individuals. It has had two main effects: reducing the national base of scientific talent and limiting the capacity of Brazilian organizations to absorb new technologies.

Absorptive capacity (AC) refers to an organization's ability to recognize, assimilate, and apply new knowledge. In the literature, this concept emphasizes its cumulative and path-dependent nature. A shortage of specialized personnel can weaken Brazil's ability to internalize and apply innovative knowledge, with implications for industrial competitiveness.

Technological innovation is one of the main drivers of economic and social development. It depends heavily on the interaction among universities, companies, and government, as proposed by the Triple Helix Model (Etzkowitz and Leydesdorff, 1995). However, the effectiveness of these interactions depends on the availability of qualified personnel who can act as boundary spanners, that is, professionals who connect knowledge generation and its practical application. These actors are particularly relevant in contexts characterized by institutional fragmentation and weak university–industry linkages. In the Brazilian context, this bridge is weakened not only by the structural limitations of Science and Technology Institutions (STIs), but also by the difficulty of absorbing and retaining talent with international experience in research and development (R&D).

Public policies for repatriating talent, such as the Conhecimento Brasil

REMUNOM
ISSN 2178-6925

Received: 13/01/2026 - **Accepted:** 03/05/2026
Vol: 13.08
DOI: 10.66104/p32n8w07
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program, aim to address scientific emigration by encouraging the return of researchers with experience in advanced technological ecosystems. The return of these professionals represents both a recovery of human resources and a potential opportunity to introduce new R&D practices, innovation management approaches, and global collaboration networks. This process may contribute to strengthening the national capacity to generate and absorb knowledge.

However, the program's potential impact is currently constrained by the absence of structured incentives for recipient companies and limited integration with existing innovation and technology transfer policies (Mukhtarov et al., 2022; Cavalcante, 2024). In addition, there is limited empirical evidence on how these returnees are effectively integrated into organizational routines and innovation processes.

n this scenario, technology transfer (TT) emerges as the central link between scientific knowledge and industrial application. It is an essential process for transforming academic discoveries into economically viable solutions (Carlos, 2023; Leite, 2021).

The effectiveness of this process depends on internal factors, particularly absorptive capacity, defined by Cohen and Levinthal (1990) as the ability to recognize, assimilate, and apply new external knowledge. This dynamic capability is influenced by human resources and by learning mechanisms within and between organizations (Zahra and George, 2002; Osabutey et al., 2024). Therefore, the presence of highly qualified personnel can be understood as a relevant enabling condition for effective TT.

In this context, a central research question emerges: How does the repatriation of qualified personnel contribute to strengthening the absorptive capacity of Brazilian companies, and how does this enhancement affect the effectiveness of TT processes from STIs?

This question has become increasingly relevant as the country seeks to consolidate its National Innovation System (NIS) and reduce external technological dependence. Recent studies indicate that the technological maturity of Brazilian academic innovations remains low, often at a technological readiness

REMUNOM
ISSN 2178-6925

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level (TRL) 3–4. The distance between universities and companies continues to be a significant barrier to TT (Ghesti, Carvalho, and Braga, 2025). This gap reinforces the need to investigate mechanisms capable of accelerating the transition from scientific knowledge to applied innovation.

This article aims to assess the potential impacts of repatriation policies for qualified personnel on the absorptive capacity of Brazilian organizations and their relationship with the effectiveness of technology transfer, based on established theoretical frameworks. Rather than providing empirical measurement, the study develops a theoretically grounded analytical interpretation of this relationship. It is assumed that the engagement of returning researchers may contribute to strengthening absorptive capacity and, under certain organizational conditions, support a virtuous cycle of innovation, expanding learning processes, reinforcing collaboration networks, and improving university–industry–government interactions.

It is expected that the findings may contribute to the debate on STI policy in Brazil and support improvements in repatriation programs, as well as better integration of institutional strategies within the innovation ecosystem. In particular, the study contributes by linking human capital repatriation policies to the microfoundations of absorptive capacity and their implications for TT effectiveness.

2. Literature Review

Cohen and Levinthal (1990) define absorptive capacity as a company's ability to recognize, assimilate, and apply new information from outside the company. This capacity reflects the firm's prior knowledge, creating a context in which R&D activities play a pivotal role in generating innovation and new learning processes that, in turn, maximize AC. The authors also note that organizations often resist investing in R&D or trading business expertise for broader knowledge, causing lost opportunities. This perspective highlights that AC is not built

REMUNOM
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instantaneously, but rather develops over time as firms accumulate knowledge and learning experience, which reinforces its cumulative and path-dependent character within organizations.

Zahra and George (2002) recast AC into four dimensions: acquisition, assimilation, transformation, and exploitation of external knowledge, classifying it as a dynamic capability. Building on this foundation, Jansen, Van den Bosch, and Volberda (2005) analyze how these dimensions are influenced by organizational antecedents such as connectivity in collaborative networks, timing, and system sharing. The authors conclude that these mechanisms are central to AC, linking it to organizational ambidexterity, defined as the ability to balance the use of existing knowledge with the development of new opportunities. In this sense, absorptive capacity emerges as something that depends not only on structure, but also on how organizations manage learning and interaction over time, particularly in environments characterized by continuous knowledge exchange.

Cohen and Levinthal (1990) also introduced the concept of "gatekeepers," individuals responsible for identifying and assimilating external knowledge, particularly in early stages. They act as boundary spanners in scientific and technical knowledge transfer. This idea becomes especially relevant when knowledge flows across borders, where individual actors often play a central role in translating and adapting external knowledge to local contexts, thereby reducing cognitive and institutional distances between organizations.

In this context, Cordero and Ferreira (2019) suggest ways to improve AC in national organizations, including talent motivation, R&D stimulation, strategic alliances, and knowledge management. Xie, Zou, and Qi (2018) examined the relationships among AC dimensions and found that transformation and exploitation capacities mediate the link between knowledge acquisition and innovation outcomes. Taken together, these contributions suggest that absorptive capacity is less a fixed attribute and more a process that depends on how organizations learn, adapt, and mobilize their human resources, especially in knowledge-intensive activities.

Mu and Jiang (2024) compare AC and the competence trap, showing that

REMUNOM
ISSN 2178-6925

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firms with strong existing expertise may underinvest in emerging technologies. Zhao et al. (2025) add that innovation performance depends on balancing similarity and complementarity in the firm's knowledge base, emphasizing partner selection and internal integration. Robertson, Caruana, and Ferreira (2023) highlight that, in emerging economies, AC often plays a more decisive role than knowledge creation itself in driving innovation performance. This is particularly relevant in contexts such as Brazil, where structural limitations make it difficult to rely solely on internal knowledge generation, increasing the importance of external knowledge absorption mechanisms.

Zhan et al. (2025) demonstrate that firms with strong absorptive capabilities can better position themselves in competitive environments, while Iqbal et al. (2025) emphasize that reducing dependence on external resources contributes to strengthening national innovation systems. Priyanka et al. (2025) identify strategic alliances as key mechanisms for enhancing AC and innovation outcomes. Fagundes and Gasparetto (2023) further describe the role of individuals as boundary spanners in interorganizational relationships. Across these studies, a recurring point is that absorptive capacity is shaped not only within firms, but also through their relationships and networks, highlighting its relational and systemic dimension.

Recent empirical studies reinforce the role of organizational capabilities in shaping innovation outcomes. Castillo and Vonortas (2024) show that ICT-specific absorptive capacity improves productivity, while Motohashi, Ikeuchi, and Yamaguchi (2025) highlight the importance of internal R&D structures and highly qualified human capital. Similarly, Aliasghar and Rose (2025) find that external partnerships are particularly beneficial for low- and medium-technology firms. These findings suggest that access to external knowledge alone is not sufficient; it needs to be supported by internal conditions that allow this knowledge to be effectively used, which again points to the centrality of organizational readiness in the absorption process.

The concept of TT, as defined by Carlos (2023), is fundamental to innovation and socioeconomic development, involving the dissemination of knowledge for

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ISSN 2178-6925

Received: 13/01/2026 - **Accepted:** 03/05/2026
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DOI: 10.66104/p32n8w07
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commercial and social purposes. As Leite (2021) argues, TT is only complete when the recipient effectively absorbs and masters the transferred knowledge. According to Osabutey et al. (2024), absorptive capacity is a determining factor in the success of TT processes and in translating knowledge into practical innovation. In this sense, the effectiveness of technology transfer depends less on the act of transfer itself and more on the conditions within the receiving organization.

Leite (2021) emphasizes that, in the Brazilian context, technological reception capacity is constrained by structural barriers, including legal and institutional fragmentation. The evolution of innovation models, from linear to interactive approaches, highlights frameworks such as National Innovation Systems (NIS) and the Triple Helix Model, which emphasize collaboration among universities, firms, and government. However, these models often assume that firms are already capable of absorbing knowledge, which is not always the case in developing economies, where internal capabilities are often unevenly distributed across firms.

In addition to human capital factors, the literature also highlights the importance of institutional and organizational conditions for effective technology transfer. Studies on innovation management based on intellectual property indicate that the conversion of knowledge into value depends not only on the existence of scientific outputs, but also on structured management practices, institutional alignment, and mechanisms that support the commercialization of technological assets. In this context, Science and Technology Institutions (STIs) play a central role, particularly through structures such as Technology Innovation Centers (TIC), which mediate interactions between academia and the productive sector and support the operationalization of technology transfer processes (Martins et al., 2026).

However, there is still limited attention in the literature to policies that directly connect human capital mobility to absorptive capacity. Existing studies highlight the importance of incentives, such as tax benefits and support for innovation investments (Mukhtarov et al., 2022). In the Chinese context, policies enabling

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ISSN 2178-6925

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autonomous entrepreneurship have been used to leverage returning talent. Cavalcante (2024) associates the Brazilian brain drain phenomenon with discontinuities in innovation policies. Even so, few studies bring these elements together in an integrated way, linking talent repatriation to absorptive capacity and, ultimately, to the effectiveness of technology transfer. This gap underpins the relevance of the present study, which seeks to articulate these dimensions within a unified analytical perspective.

3. Methodology

In terms of the theoretical procedure, this research consists of a structured narrative literature review combined with a qualitative and exploratory analytical approach, considering the theoretical references adopted (Gil, 2002), with the objective of examining the potential contributions of the "Conhecimento Brasil" program to the enhancement of AC in Brazilian companies.

It is important to note that the study does not aim to provide empirical measurement, but rather to develop an analytical interpretation based on existing theoretical and policy-oriented literature, with emphasis on the conceptual relationships between absorptive capacity, human capital, and technology transfer.

A comprehensive bibliographic search was conducted to map the state of the art regarding the qualitative aspects of the present study, using the Scopus and Web of Science databases between 2000 and 2025, via the Boolean expression "absorptive capacity" AND "human capital," yielding a total of 275 scientific articles. The selection of these articles was based on predefined inclusion criteria, considering alignment with the study objective, the presence of explicit discussion on absorptive capacity and human capital, and their applicability to emerging economies. Studies not directly related to these themes, as well as duplicates, were excluded.

Furthermore, an additional search was conducted on Google Scholar using the keywords "academic spin-off," "university spin-off," "research-derived

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company," and "research spin-off", with the aim of complementing the discussion on knowledge commercialization and entrepreneurial mechanisms associated with technology transfer.

Regarding the results of the aforementioned searches, only scientific articles were selected, with priority given to those published from 2020 onward, in order to incorporate more recent discussions on entrepreneurship, innovation ecosystems, and knowledge commercialization, particularly in relation to TT processes. After the screening process, a subset of articles considered most relevant to the analytical objectives of the study was selected for in-depth analysis.

The analysis of the selected literature followed an interpretative approach, focusing on identifying convergences, complementarities, and gaps related to the relationship between human capital mobility, absorptive capacity, and TT. Rather than applying a formal systematic review protocol, the study adopts a structured narrative synthesis, aligned with its exploratory objective. This approach allows for a theoretically grounded discussion, while acknowledging the absence of direct empirical validation regarding the impact of the analyzed program.

4. Results and Discussion

Regarding the "Conhecimento Brasil" program implemented by FINEP, which aims to attract researchers to large and medium-sized enterprises to strengthen their innovative capacity (MCTI; FINEP; FNDCT, 2024), it is possible to interpret this initiative as a strategy to leverage the intellectual capital of researchers who emigrated from the country in order to strengthen the absorptive capacity of Brazilian firms.

From a theoretical perspective, this may contribute to improving the conditions for TT, although such effects depend on organizational and institutional factors discussed in the literature. However, this approach diverges from China's policy (Shi, Liu, and Wang, 2020), as it does not prioritize incentives for researchers to engage in autonomous entrepreneurship, which limits the potential diversification of innovation outcomes, particularly in terms of the creation of new

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ISSN 2178-6925

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technology-based ventures.

An important consideration is that there is little incentive for companies participating in the "Conhecimento Brasil" program to capitalize on tax incentives and economic subsidies for capital investments (Mukhtarov et al., 2022). This fact may inhibit technology-based entrepreneurial initiatives resulting from TT from academic research, reducing the potential spillover effects of repatriation policies, especially for smaller and emerging firms.

The effectiveness of TT initiatives is intrinsically linked to the recipient's absorptive capacity. This concept directly concerns an organization's aptitude to acquire, assimilate, transform, and exploit knowledge and technologies to establish competitive advantages and market positioning.

As noted by Osabutey et al. (2024), this capacity is a determinant of innovation, which reinforces its central role in the present analysis, particularly when considering the role of highly qualified human capital in facilitating these processes.

In this context, the concept of the Triple Helix (Etzkowitz and Leydesdorff, 1995) is discussed, suggesting the need for dynamic interaction among government, university, and business actors. Structuring R&D sectors in companies is a relevant condition for the effective integration of these actors, revealing an opportunity to absorb repatriated scientists as potential intermediaries in this process, especially in environments where such integration is still limited, as is often observed in the Brazilian context.

Considering that the technologies developed in STIs generally have a low TRL, which may affect their attractiveness and the absorptive capacity related to TT (Ghesti et al., 2025), the incorporation of repatriated scientists can be interpreted as an organizational strategy that may increase the likelihood of successful TT implementation, by reducing part of the uncertainty associated with early-stage technologies and facilitating their progression toward more advanced stages of development.

Enhancing AC through the integration of repatriated personnel can generate a cumulative dynamic over time. Since this integration requires a pre-existing level

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ISSN 2178-6925

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of organizational AC, the process itself may facilitate future external collaborations and even further recruitment. This dynamic is reinforced by the development of HR capabilities, which, as noted by Cruz et al. (2020), further contribute to strengthening the firm's overall absorptive capacity, suggesting a cumulative reinforcement mechanism over time, rather than a one-time effect.

Furthermore, the integration of repatriated personnel can serve as a mechanism to mitigate the specific challenges within the Brazilian context regarding the application of public law by STIs. As noted by Leite (2021), these legal constraints often hinder the translation of academic knowledge into innovations within industrial sectors governed by private law. In this regard, repatriated professionals can act as intermediaries, bridging the gap between universities and firms, particularly concerning the legal complexities of such partnerships, acting not only in technical terms, but also in institutional dimensions, which is often overlooked in traditional analyses of TT.

In this scenario, effective organizational engagement in knowledge management is essential for structuring robust AC for assets derived from TT (Ribeiro et al., 2025). Within this context, policies aimed at absorbing and retaining repatriated personnel can help mitigate the effects of high staff turnover and the scarcity of resources for hiring qualified professionals in public administration, factors that otherwise impede the internalization and sustainability of new knowledge (Ferreira Silva et al., 2025), although the effectiveness of these measures depends on the specific organizational conditions in which they are implemented.

Considering the essential nature of TT actions for innovation and, ultimately, for socioeconomic development (Carlos, 2023), AC suggests a potential relationship with TT capabilities, reflected in organizational financial performance and increased success rates of corporate projects (Zou, Ertug, and George, 2018), even though such outcomes are not directly measured in this study, which should be interpreted as a limitation of the present analysis.

Reducing reliance on external aid emerges as a critical factor. This reduction may enhance the innovative capacity of both actors in the National Innovation

REMUNOM
ISSN 2178-6925

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System and potentially foster TT. Specifically, integrating repatriated professionals can be understood as a mechanism that may support technology transfer between STIs and industrial organizations (Iqbal et al., 2025), particularly by strengthening internal capabilities rather than external dependence, which aligns with long-term innovation policy objectives.

The effects of absorbing personnel repatriated through the program align with the corporate need to recognize, assimilate, and apply information related to the technological development of products and processes (Cohen and Levinthal, 1990). Furthermore, this absorption enables the transformation and exploitation of such knowledge (Zahra and George, 2002). This dynamic directly fosters R&D initiatives and connections with foreign collaborative networks, strengthening the organizational antecedents of connectivity described by Jansen, Van den Bosch, and Volberda (2005). Ultimately, these factors may contribute to strengthening AC and, consequently, increase the likelihood of success in TT initiatives, within the analytical framework proposed in this study, without implying direct empirical validation.

The contribution of repatriated researchers can be further understood through the four dimensions of absorptive capacity proposed by Zahra and George (2002): acquisition, assimilation, transformation, and exploitation. This perspective allows for a more structured interpretation of how highly qualified human capital may influence organizational learning and technology transfer processes.

Repatriated researchers may influence absorptive capacity across its main dimensions. In terms of acquisition, they can expand the organization's ability to identify and access external knowledge, particularly through their experience in international research environments and participation in global networks. Regarding assimilation, these professionals may contribute to translating and adapting external knowledge to the internal context of the firm, including not only technical content, but also research practices and methodological approaches.

In the transformation and exploitation dimensions, repatriated researchers may support the recombination of new and existing knowledge and its

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ISSN 2178-6925

Received: 13/01/2026 - **Accepted:** 03/05/2026
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incorporation into organizational routines, which can enable its practical application in technology transfer, product development, and process innovation.

However, these effects are not automatic and depend on organizational conditions, such as existing capabilities, managerial support, and access to resources. As a result, returnees can be interpreted as boundary spanners related to international collaboration networks, the so-called gatekeepers, focused on strategies to enable technology transfers from the external environment (Cohen and Levinthal, 1990). These can be understood as potential effects of corporate investment in the capacity to recognize and assimilate external knowledge, benefiting the company with TT actions, especially in contexts of international knowledge circulation, where access alone is not sufficient without internal absorption mechanisms.

5. Conclusion

The objective of this study was to examine the potential relationship between Brazil's policy to repatriate qualified personnel and the absorptive capacity associated with technology transfer from academic research centers. Given existing theoretical frameworks, it is possible to suggest that leveraging the benefits of the Conhecimento Brasil program (the FINEP-developed part) may represent a viable strategy from an analytical and theoretical perspective.

Specifically, employing qualified researchers repatriated to Brazil may contribute to strengthening the absorptive capacity of industrial sectors, thereby supporting the conditions necessary to benefit from the reception of new technologies, although such effects depend on complementary institutional and organizational factors, which may vary across sectors and firm capabilities.

The literature indicates that other relevant nations, such as China, have established repatriation policies explicitly focused on increasing the absorptive capacity of national productive sectors. These countries have reported favorable results in the literature, particularly in improving researcher retention, thereby supporting the overall success of repatriation programs. However, these

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Vol: 13.08
DOI: 10.66104/p32n8w07
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experiences are shaped by specific institutional contexts, which reinforces the importance of aligning talent policies with broader innovation strategies, rather than treating them as isolated initiatives.

Regarding strategic recommendations, it was noted that the current program does not include funding lines for small businesses. This highlights a lack of incentives for researchers to pursue autonomous initiatives in new technology-based ventures. If such ventures were integrated into the Brazilian Innovation System, their AC could be strengthened by the founders' expertise, enabling them to benefit from technology transfers developed in academic environments, while also contributing to a more diversified and dynamic innovation ecosystem, especially by expanding participation beyond large and medium-sized firms.

Thus, this study contributes to the state of the art regarding absorptive capacity and technology transfer by linking these concepts to the analytical potential of the Brazilian government's researcher repatriation program. This provides a theoretical foundation that may support the discussion of policy alternatives aimed at increasing the innovation capacity of productive sectors, specifically by enhancing their ability to access technologies developed in both national and international research environments, and by emphasizing the role of human capital as a key enabler of these processes, within the broader dynamics of the National Innovation System.

Regarding limitations, it is important to state that this is a purely conceptual analysis. Consequently, practical outcomes depend on other factors, such as laboratory infrastructure, bureaucratic processes, corporate innovation culture, and management's risk appetite in beneficiary firms. These factors indicate opportunities for further research and highlight the need for future empirical validation, particularly through firm-level or program-level analyses.

For future research, we suggest investigating how the addition of new researchers alters internal practices, research culture, and the R&D structures of companies. Furthermore, it would be valuable to evaluate the impacts of this personnel absorption through the lens of the collaborative networks these researchers bring, and to compare the productivity indices of repatriated

REMUNOM
ISSN 2178-6925

Received: 13/01/2026 - **Accepted:** 03/05/2026
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researchers with those of their peers who remained abroad, in order to better understand the long-term effects of repatriation policies, as well as their broader implications for innovation performance.

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