

Analysis of the Brazilian railway system: concession renewals and the quest for a more diversified and competitive framework

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Abstract

Purpose – This paper provides a comprehensive analysis of the Brazilian freight railway system, examining the efficacy of the current concession renewal model in light of persistent structural problems such as market concentration, cargo dependence on export commodities and underutilization of the network. Situating Brazil within the broader international debate on railway reforms, the paper evaluates whether the ongoing early renewal of concessions can deliver a more diversified and competitive freight system.

Design/methodology/approach – The study adopts a sequential mixed-methods research design that integrates longitudinal quantitative analysis with qualitative institutional and policy evaluation. The quantitative component examines time-series indicators published by ANTT, DNIT and INFRA S.A. from 1999 to 2023 to identify structural patterns in traffic growth, investment, safety and market concentration. The qualitative component employs a process-tracing logic to reconstruct the evolution of concession renewals and the implementation of Railway Law 14.273/2021, drawing on concepts from regulatory economics, institutional theory and industrial organization. These empirical streams are synthesized through an analytical framework that connects three dimensions - regulatory design, market structure and system performance - allowing for a systematic assessment of how Brazil's institutional configuration shapes incentives, competitive dynamics and network utilization.

Findings – The analysis confirms that the early renewal of concessions has successfully secured substantial private investment for capacity expansion on existing trunk lines. However, it has perpetuated the vertically integrated model, reinforcing the market power of incumbent operators and failing to significantly promote intramodal competition or cargo diversification. The system remains dominated by iron ore and agricultural commodities, with general cargo representing a minuscule share. The new authorization regime and short-line railway policies present a viable pathway for market opening but face significant operational and institutional barriers to implementation.

Originality/value – This research offers a timely and critical assessment of a pivotal moment in Brazilian railway policy. It moves beyond a simplistic evaluation of volume growth to a structural analysis of market failures and the interplay between concession renewal and regulatory innovation. The findings provide actionable insights for policymakers in Brazil and other emerging economies seeking to balance private



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investment with public interest goals in railway infrastructure, highlighting the necessity of complementary, pro-competitive measures alongside financial investment.

Keywords Authorization regime, Brazil, Cargo diversification, Economic resilience, Infrastructure policy, Market concentration, Railway concessions, Regulatory framework, Short-line railways, Transport planning, Transport policy, Transportation privatization

Paper type Research article

1. Introduction

The configuration of a nation's freight railway system is a critical determinant of its economic efficiency, logistical resilience, and regional integration. In Brazil, a country of continental dimensions, the performance of this sector is paramount. The privatization process of the late 1990s, which transferred the operation of the federal railway network to private concessionaires, is widely credited with rescuing the system from a state of advanced decay (BNDES, 2019). Significant investments led to a remarkable recovery in transported volumes and operational safety, transforming the railways into a vital artery for Brazilian exports (ANTT, 2023a).

However, nearly three decades after this initial reform, a more nuanced diagnosis reveals persistent and profound structural challenges. The system exhibits an extreme dependency on a limited range of bulk commodities. In 2022, iron ore and agricultural products collectively accounted for over 90% of the roughly 30 million tonnes transported, relegating manufactured and containerized goods - the backbone of a diversified internal market - to a negligible share of less than 2% (ANTT, 2023a). This cargo concentration is a direct consequence of a highly concentrated market structure, dominated by four major groups - Rumo, VLI, MRS, and Vale - whose operations are often intrinsically aligned with the export logistics of their controlling shareholders in the mining and agribusiness sectors (Assis *et al.*, 2017).

Compounding this issue is the paradoxical underutilization of the network. Despite growth in absolute volumes, large portions of the infrastructure remain idle. A 2019 industry survey indicated that 58% of the roughly 30,000 km of conceded network was practically unused, with about 12,000 km completely inoperative (Revista Ferroviária, 2019). Concessionaires, driven by rational economic logic, have concentrated investments on high-density trunk lines connecting production hubs to ports, while regional branches that could serve dispersed domestic industries have been largely abandoned. This operational focus results in a system that is both technically efficient for specific flows yet inefficient from a broader national logistics and service quality perspective, where high technical efficiency can coincide with lower economic efficiency and a worsening of service quality (Victorino & Bertussi, 2023). Furthermore, this model has significant environmental implications, as the reliance on diesel traction for many lines, particularly in regions like the Northeast, contributes substantially to the sector's greenhouse gas emissions (Soares, Eliziário, Galvêncio, & Ramos-Ridao, 2024), highlighting another dimension of inefficiency that extends beyond purely economic metrics.

The sector also faces a critical human capital challenge. The near-extinction of specialized railway engineering education in the late 20th century, followed by its recent resurgence, underscores a historical fragility in the knowledge base necessary for innovation and systemic diversification (Asaff, Grubisic, Scalice, & Dias, 2015). A skilled workforce is essential not only for maintaining existing operations but also for driving the technological modernization and managerial innovation required for a more complex and diversified railway system. The regulatory framework itself has been historically characterized by a repressive and ex-post approach, with quality-of-service indexes in concession contracts proving insufficient to drive meaningful improvements (Gomes, 2019), a fact corroborated by efficiency analyses that show a trade-off between profitability and service quality (Victorino & Bertussi, 2023).

It is within this context that the current wave of early concession renewals gains significance. With the original 30-year contracts nearing expiration, the federal government, motivated by fiscal constraints and slow progress on new greenfield projects, has adopted a

strategy of anticipatory renewal. This process, guided by the Investment Partnerships Program (PPI), offers contract extensions in exchange for substantial new investment commitments and grant fees (INFRSA, 2023). This presents a critical juncture: is the renewal process merely a mechanism to secure further investment in the existing commodity-export paradigm, or can it be leveraged as a catalyst to introduce greater competition and diversification?

This paper argues that while the early renewal model is effective for capital injection, it is insufficient, on its own, to address the sector's core structural deficiencies. The analysis will demonstrate that the renewal of vertically integrated concessions reinforces existing market power and fails to correct the misalignment between private profitability and public service quality, a trade-off identified in efficiency analyses of the sector which consistently point to low average efficiency scores and stagnation (Pereira, da Rosa, & Lunkes, 2015; Marchetti & Wanke, 2017; Victorino & Bertussi, 2023). The potential for transformative change lies instead in the synergistic application of this renewal process with innovative regulatory instruments, particularly the new authorization regime and the promotion of short-line railways introduced by the Legal Framework for Railways (Law 14.273/2021). These new models can potentially unlock underutilized network sections, attract new players, and foster a more competitive and diversified market structure, thereby addressing the historical limitations of the concession model. This approach aligns with findings that a constant returns to scale prevails in the sector (Silva, Macambira, & Rocha, 2019), suggesting that smaller, specialized operators can be efficient. A holistic view that integrates economic, operational, and environmental dimensions (Kaewunruen, Sresakoolchai, & Peng, 2020) is crucial, as is evaluating the broader impacts of network expansion (Holler Branco, Bartholomeu, Alves Junior, & Caixeta Filho, 2022). Ultimately, a regulatory shift that explicitly incorporates service quality into efficiency assessments (Link, 2019) is vital for aligning private incentives with public interest.

The paper is structured as follows. Section 2 provides a historical overview of the privatization and subsequent market consolidation. Section 3 details the research methodology. Section 4 presents a performance assessment, highlighting the dichotomy between quantitative successes and qualitative deficiencies. Section 5 critically examines the early renewal process and its outcomes. Section 6 explores the potential of new regulatory models. Finally, Section 7 discusses the findings and proposes policy recommendations, followed by the conclusion in Section 8.

2. Literature review and historical context

2.1 The Brazilian context: historical evolution and current market structure

The contemporary structure of the Brazilian railway system cannot be understood without examining the historical process that led to it. The state-led era, particularly from the 1980s onwards, was marked by severe underinvestment and operational decline. The network, managed by the Brazilian Federal Railways (RFFSA), was stagnant, technologically outdated, and financially unsustainable (Castro & Lamy, 1994). This context set the stage for the radical reform implemented under the National Privatization Program (Law 8031/90).

The concession model adopted was one of vertical integration, where the concessionaire assumed control over both the infrastructure (tracks, signalling) and operational services on its designated regional network. These networks were auctioned between 1996 and 1998 for 30-year terms (see Table 1). A distinctive feature was the absence of pre-defined investment quotas; instead, concessionaires were given operational autonomy and assessed against performance targets, primarily focused on increasing transport volume and reducing accidents (Sousa & Prates, 1997). This model was successful in its primary goal: attracting private capital to rehabilitate a crumbling system. As Marques (2019) noted, the immediate post-privatization period was characterized by operational improvements and productivity gains, even before massive capital expenditures materialized.

Table 1. Initial railway concessionaires (1996–1999)

Regional network	Concessionaire	Start of operation	Length (km)
Oeste	Ferrovias Novoeste S.A.	01.07.96	1,621
Centro-Leste	Ferrovias Centro-Atlântica S.A. (FCA)	01.09.96	7,080
Sudeste	MRS Logística S.A.	01.12.96	1,674
Tereza Cristina	Ferrovias Tereza Cristina S.A.	01.02.97	164
Sul	ALL-América Latina Logística	01.03.97	6,586
Nordeste	Companhia Ferroviária do Nordeste (CFN)	01.01.98	4,238
Paulista	Ferrovias Bandeirantes S.A.	01.01.99	4,236
Total (RFFSA)			25,599

Source(s): Adapted from Agência Nacional de Transportes Terrestres – ANTT (2023b)

A critical evolution, extensively analyzed by Assis *et al.* (2017), was the market consolidation that followed the initial concessions. Through mergers and acquisitions, the landscape transformed from multiple regional players to a highly concentrated oligopoly. The Rumo Logística group absorbed the Oeste, Sul, and Paulista networks, becoming the largest operator by reach. The Ferrovias Centro-Atlântica (FCA) was integrated into VLI Logística, a company with significant control by Vale. This consolidation created the current dominant players, whose ownership structure is a key explanatory variable for the system’s cargo concentration:

- (1) *MRS Logística*: Its shareholding is a consortium of its primary clients, including Vale (10.9%), CSN (18.6%), and other mining/steel companies (MRS, 2019). Unsurprisingly, over 80% of its cargo is iron ore.
- (2) *VLI Logística & Vale’s Railways (EFVM/EFC)*: Despite VLI’s stated goal of diversification, Vale’s influence and the core function of its owned railways ensure a primary focus on iron ore transport.
- (3) *Rumo Logística*: Controlled by the Cosan group, a powerhouse in agribusiness, its operations are predominantly focused on transporting agricultural commodities from the Brazilian Midwest to port terminals.

This corporate structure has led scholars to describe the system as a collection of “private-use railways” or “captive networks,” where the infrastructure functions as an optimized extension of the shareholders’ internal logistics chains (CNT, 2013). This creates a fundamental misalignment with the public interest objective of a common-user railway network that is accessible to all shippers, a theme central to the current policy debate.

2.2 Theoretical foundations and international comparative perspectives

To transcend a purely descriptive account of Brazil’s railway evolution, this analysis must be situated within broader theoretical frameworks and comparative international experiences. The global discourse on railway restructuring fundamentally revolves around the central tension between two competing paradigms: vertically integrated monopolies that promise economies of scope and investment incentives, versus vertically separated structures that prioritize competition and allocative efficiency (Gómez-Ibáñez, 2003; Winston, 2010). This dichotomy manifests in distinct regulatory approaches worldwide, each with demonstrated trade-offs.

The European Union’s mandated “vertical separation” model, implemented through Directive 91/440/EEC and subsequent railway packages, represents the most comprehensive experiment in creating contestable rail markets through institutional separation of

infrastructure management from service operation (Nash & Rivera-Trujillo, 2004; Crozet, 2017). Empirical studies of this approach reveal mixed outcomes: while intramodal competition has increased in certain freight corridors like the Rhine-Alpine route, achieving genuine competition has required extensive regulatory oversight and substantial transaction costs (Friebel, Ivaldi, & Vibes, 2010). Conversely, the North American model - characterized by privately-owned, vertically integrated Class I railroads operating in parallel competition - demonstrates how high density corridors can achieve remarkable operational efficiency while maintaining profitability, though at the cost of limited network access for competitors (Winston, 2010; Pittman, 2011).

For emerging economies, the reform calculus incorporates additional dimensions of institutional capacity, fiscal constraints, and developmental imperatives. India's experience with allowing private container train operators on state-owned infrastructure under a "right to use" model since 2006 illustrates both the potential for attracting private investment and the persistent challenges of managing interface conflicts between incumbents and new entrants (Gangwar, 2020; Jain & Raghuram, 2021). China's approach of maintaining state ownership while corporatizing operations and gradually introducing competition in certain segments presents yet another hybrid model, one that has achieved massive capacity expansion while grappling with efficiency and service quality issues (Zhang *et al.*, 2019; Fu *et al.*, 2012). South Africa's continued struggle with Transnet Freight Rail's monopoly, despite periodic reform attempts, underscores the entrenched nature of vertical integration in commodity-dependent economies (Casteleijn & Mashiri, 2019).

Theoretical contributions from New Institutional Economics further illuminate Brazil's situation. Transaction cost theory suggests that vertical integration may be efficient for asset-specific, high-volume flows like iron ore, where relationship-specific investments predominate (Williamson, 1985). However, this comes at the opportunity cost of reduced system adaptability and innovation (Pittman, 2011). The concept of "appropriability regimes" in innovation theory (Teece, 1986) helps explain why incumbent operators focused on bulk commodities have limited incentive to develop capabilities for handling diversified cargo, as their specialized assets and routines are optimized for their core business.

Recent comparative efficiency analyses reinforce the significance of institutional design. A meta-analysis of railway reforms in 28 countries by Cantos, Pastor, and Serrano (2012) found that the introduction of competition, rather than privatization per se, correlated most strongly with productivity improvements. More specifically, Rivera-Trujillo (2018) demonstrates through panel data analysis that countries implementing open access regimes experienced faster growth in non-bulk freight shares than those maintaining vertically integrated structures. These international insights establish crucial benchmarks against which Brazil's reform trajectory can be evaluated, moving the analysis beyond parochial assessment toward globally-informed policy evaluation.

This comparative perspective underscores that regulatory design is not merely a legal or administrative exercise, but a determinant of market incentives, contestability, and long-term system performance. Countries adopting structural separation have relied on strong regulatory agencies to manage capacity allocation and ensure non-discriminatory access, whereas hybrid and right-to-use models have succeeded only when supported by transparent pricing methodologies and robust enforcement mechanisms. These international configurations provide an analytical baseline against which Brazil's institutional choices can be examined.

3. Research methodology

This research adopts a mixed-methods approach that combines longitudinal quantitative analysis with qualitative policy and institutional assessment. On the one hand, a time series of key performance indicators is examined to capture the evolution of freight volumes, productivity, safety and network utilization from the initial concessions to the present. On the other hand, a regulatory economics perspective is applied to reconstruct and interpret the main

policy instruments – in particular the early renewal contracts, the new Railway Law, and the emerging authorization and short-line frameworks – in terms of their implications for market structure, competition and cargo diversification.

3.1 Data collection

Primary data was sourced from the official publications and databases of key Brazilian regulatory and infrastructure bodies:

- (1) *ANTT (National Land Transport Agency)*: The ANTT Annual Statistical Reports (2020–2023) provided data on transport volume (tonnes and TKU), cargo composition, accident rates, and network extension. Documents related to specific concession renewals were also consulted.
- (2) *DNIT (National Department of Transport Infrastructure)*: The National Transportation Plan (PNV, 2034) and historical records were used to understand the long-term planning context and the status of the federal network.
- (3) *INFRA SA*: Reports from the Investment Partnerships Program (PPI) detailing the terms, investment commitments, and grant fees associated with early concession renewals and new authorization projects were analyzed.

Secondary data was gathered from academic literature, including peer-reviewed journal articles, sectoral studies from the Brazilian Development Bank (BNDES), and industry reports.

3.2 Analytical framework

The analytical framework combines a longitudinal assessment of sectoral performance with a comparative perspective on railway regulation. Building on international experiences of railway restructuring and privatization (e.g. [Thompson, 2003](#); [World Bank, 2017](#); [Friebel et al., 2010](#); [Ait Ali, Link, & Nilsson, 2022](#)), the study considers three interrelated dimensions: (1) regulatory design, including the allocation of property rights over infrastructure and rolling stock, the existence and strength of independent regulation, and the rules governing open access and public service obligations; (2) market structure, captured by the degree of vertical integration, the presence or absence of intramodal competition “for” and “in” the market, and the extent of cargo and operator concentration; and (3) performance outcomes, measured in terms of efficiency, cargo diversification, network utilization, service quality and resilience.

Empirically, the framework is operationalized by, first, describing the policy instruments that shape each dimension – notably, the original concession contracts, the formal and de facto rules of access to incumbent networks, the early renewal agreements, and the new authorization and short-line arrangements. Second, the evolution of quantitative indicators is examined in light of this institutional trajectory, allowing the paper to discuss how changes in regulatory design have reinforced or mitigated structural problems such as oligopolistic market power, network underutilization and narrow cargo portfolios.

To operationalize this analytical strategy and link institutional design, market structure, and performance outcomes in a systematic manner, the study draws on an integrated framework organized into three mutually reinforcing modules, which guide both the empirical description and the interpretive analysis presented in the subsequent sections.

3.2.1 Module 1: regulatory architecture and institutional design. The first module focuses on the regulatory and institutional architecture governing Brazil’s freight railways. Inspired by classical frameworks on regulatory governance ([In Levy & Spiller, 1994](#); [In Hancher & Moran, 1989](#)), it assesses the formal and de facto capacity of institutions such as ANTT, the Ministry of Transport, and INFRA S.A. to enforce non-discriminatory access, oversee concession performance, and discipline strategic behaviour by incumbents. Drawing on the theory of incomplete contracts ([Hart, 2003](#)), the module examines how concession design,

renegotiation mechanisms, and early renewal arrangements shape investment incentives, risk allocation, and operators' degree of discretion. It also considers how Brazil's institutional endowments - including judicial processes, legislative stability, and administrative capabilities - influence the feasibility and credibility of regulatory interventions aimed at promoting competition, cargo diversification, and network revitalization. This institutional reading establishes the foundation for understanding the constraints and opportunities embedded in Brazil's concession-based governance model.

3.2.2 Module 2: market structure and competitive dynamics. The second module analyses how institutional arrangements translate into observable market structures and competitive dynamics. Building on industrial organization theory, particularly the structure–conduct–performance paradigm (Bain, 1956) and regulatory economics (Laffont & Tirole, 1993), it interprets vertical integration not as a binary condition but as a continuum reflecting degrees of operational, informational, and contractual control. Rather than computing formal indices, the module qualitatively assesses concentration patterns, barriers to entry, and the contestability of the network—considering factors such as sunk costs, access pricing practices, path allocation rules, and incumbents' strategic behaviour (Baumol, Panzar, & Willig, 1982; Pittman, 2011). It also incorporates path-dependence insights (Pierson, 2000), recognizing that Brazil's market configuration reflects cumulative decisions - privatization design, asset ownership by bulk shippers, and limited enforcement of access rights - that continue to shape the system's capacity to accommodate new operators and diversified cargo profiles.

3.2.3 Module 3: multi-dimensional performance assessment. The third module provides a multi-dimensional lens for evaluating performance beyond conventional measures of freight volume and productivity. Adapting international assessment frameworks (OECD/ITF, 2019; Link, 2019), it incorporates dimensions of static efficiency (asset utilization, safety outcomes), dynamic efficiency (investment patterns, technological upgrading), allocative efficiency (the extent to which the system serves heterogeneous shippers and regions), and system resilience (capacity to support multimodal integration and sustain operations under shocks). While the empirical component relies primarily on available official indicators, the conceptual structure allows the analysis to interpret persistent problems - such as narrow cargo specialization, network underutilization, and uneven territorial coverage - not as isolated outcomes but as manifestations of deeper institutional and competitive dynamics captured by Modules 1 and 2. This multi-layered approach ensures that performance appraisal remains consistent with the analytical claims advanced throughout the paper.

3.3 Theoretical framework: regulation, market structure and performance

To structure the empirical and institutional analysis, the study adopts an integrated analytical framework linking regulatory design, market structure, and system performance. Figure 1 summarizes the causal architecture underpinning this framework.

The theoretical lens underlying this analysis is drawn from regulatory economics and the literature on infrastructure industries. In freight railways, high sunk costs and economies of density in track infrastructure justify some degree of monopoly at the infrastructure level, but competition can be introduced through various models of vertical integration and access. Comparative studies show that reforms have typically moved from state-owned, vertically integrated monopolies towards more complex structures that combine private participation, access regimes and, in some cases, vertical separation (Thompson, 2003; World Bank, 2017; Friebe et al., 2010; Ait Ali et al., 2022). Within this spectrum, sector performance depends on how effectively regulatory instruments align private investment incentives with public objectives such as network utilization, cargo diversification and environmental benefits.

In this perspective, vertically integrated concessions owned or controlled by dominant shippers tend to prioritize high-density, export-oriented flows, particularly when access rules are weak or not credibly enforced. Conversely, regimes that combine transparent capacity allocation, cost-oriented and non-discriminatory track charges, and credible enforcement

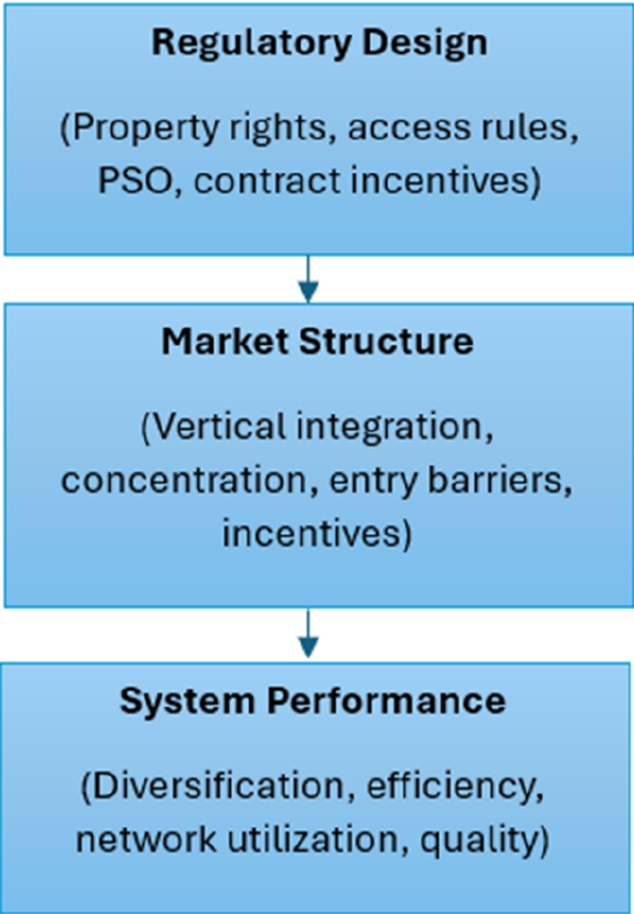


Figure 1. Integrated analytical framework

mechanisms are more likely to support entry by independent operators and short-line companies, fostering intramodal competition and broadening the freight portfolio (Casullo, 2016; ACCC, 2021). The Brazilian case is thus interpreted as a specific configuration within this broader menu of institutional options: one in which early concession renewals and emerging open-access and authorization schemes coexist with entrenched vertical integration and concentrated cargo ownership, with ambiguous consequences for competition and system-wide performance.

4. Performance assessment: a tale of two realities

The performance of the concessioned railway system presents a paradox of undeniable success alongside profound structural deficiencies.

4.1 Quantitative successes

On quantitative metrics, the system’s revival is clear. Since the first round of concessions, freight volumes have grown substantially, labour and asset productivity have improved, and

accident rates have fallen, reversing the pre-privatization trend of chronic underinvestment and operational decline. These improvements are consistent with early assessments of the Brazilian reforms, which documented significant gains in traffic, labour productivity and safety in the first decade after privatization (Estache *et al.*, 2001), and with broader Latin American evidence of post-concession productivity growth (World Bank, 2017; OECD/ITF, 2014). In this sense, Brazil shares with countries such as Mexico the experience of using concessions to stabilize and modernize core freight corridors, achieving sizeable efficiency gains on the main export routes. As quantitative indicators reveal, the concessions generated substantial gains in traffic volume, safety, and investment, although these improvements were unevenly distributed across the network. Table 2 summarizes the main before–after changes in key performance indicators.

4.2 Qualitative and structural deficiencies

Beneath these aggregate numbers lies a more troubling reality. The cargo matrix of the Brazilian freight railway system remains exceptionally narrow, with iron ore and a few agricultural commodities dominating volumes and revenues, while higher value-added manufactured goods and containerized cargo continue to rely predominantly on road transport. Cross-country benchmarking indicates that railway systems with similar or even lower traffic densities have managed to sustain a broader commodity mix when institutional arrangements provide clearer incentives for intramodal competition and non-discriminatory access (Niu, Li, Zhang, Deng, & Chang, 2023; Ait Ali *et al.*, 2022). In Brazil, by contrast, the combination of vertical integration, ownership by major commodity producers and limited enforcement of access rules has encouraged a focus on dense export corridors, leaving many potential markets – including general cargo and regional industries – either underserved or entirely disconnected from the rail network, as can be seen in Figure 2.

Furthermore, the physical network is characterized by severe underutilization and spatial fragmentation. Large portions of the originally concessioned network are either inactive, operated at very low frequencies, or devoted almost exclusively to a single commodity flow, despite being physically capable of supporting a more diversified traffic mix. Similar patterns have been observed in other Latin American freight systems, where concessionaires concentrated investments on high-density corridors while low-density branches were abandoned or mothballed (OECD/ITF, 2014; World Bank, 2020). In the Brazilian case, the coexistence of highly productive export corridors and underused or dormant branches illustrates the tension between private profitability and the broader public interest in building a resilient and territorially integrated transport system.

Table 2. Key performance indicators before and after railway concessions in Brazil

Indicator	Pre-privatization (1990–1996)	Post-privatization (2000–2020)	Source
Total freight volume (million tonnes)	146	491	ANTT (2023a)
TKU (billion)	~100	289	ANTT (2023a)
Accident rate (accidents/million train-km)	17.2	4.6	ANTT (2023a)
Active network (km)	22,000	15,000 effectively used	CNT (2013), Revista Ferroviária (2019)
Cargo composition (share iron ore)	65%	78%	ANTT (2023a)
General cargo share	~5%	<2%	ANTT (2023a)
Average investment (R\$ billion/year)	<1.0	>6.0	BNDES (2019), ANTT (2023b)

COMPOSITION OF RAILWAY CARGO TRANSPORT IN BRAZIL
(2022)

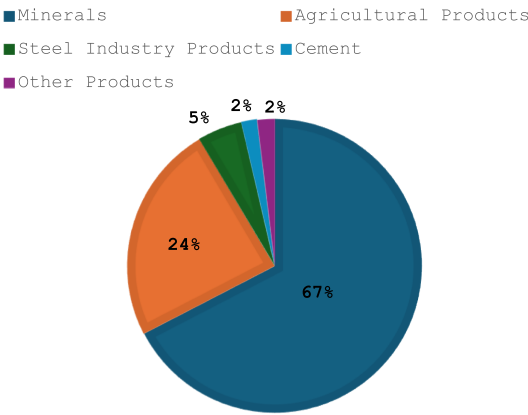


Figure 2. Composition of railway cargo transport in Brazil (2022). Source: Based on ANTT (2023a) data

The structural imbalance becomes even clearer when visualized in terms of operational use of the network. As illustrated in Figure 3, only a fraction of the granted network is effectively utilized, with more than one third remaining inactive or operating at minimal density.

5. The early renewal process: securing investment, entrenching structure

The Brazilian government’s response to these challenges, constrained by fiscal limitations, has been to prioritize the early renewal of existing concessions. Initiated around 2018 and formalized through PPI Resolution 42/2018, this strategy uses the concessionaires’ desire for operational certainty as a bargaining chip to secure new investments and update contractual terms.

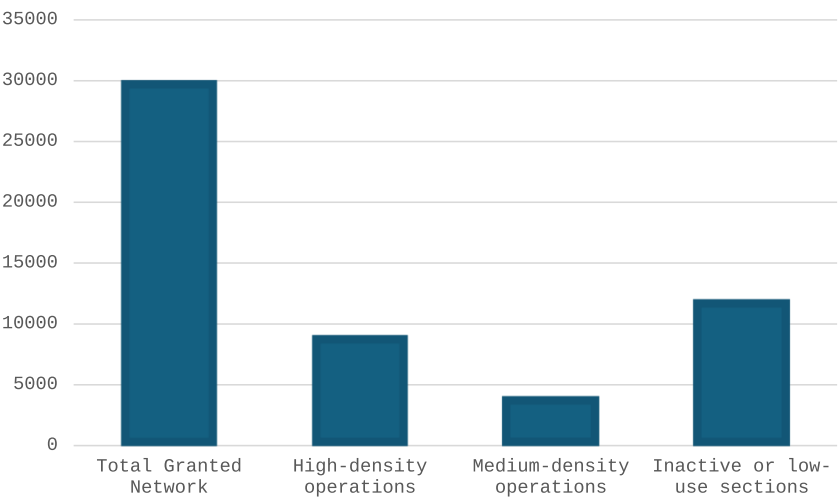


Figure 3. Operational use of the Brazilian railway network. Source: ANTT (2023a, b), CNT (2013), Revista Ferroviária (2019)

The standard model for early renewal (Table 2) involves a package of measures:

- (1) *Contract Extension*: Adding 30 years to the original concession term.
- (2) *Binding Investment Commitments*: The concessionaire agrees to a detailed, multi-year investment plan focused on capacity expansion, modernization, and mitigating urban conflicts on its core network.
- (3) *Grant Fee (“Outorga”)*: A significant one-time payment from the concessionaire to the public treasury.
- (4) *Cross-Investment*: A portion of the collected grant fees is allocated to finance new strategic greenfield projects identified by the government, such as the EF-354 (FICO) and the Northern São Paulo Ferroanel (INFRA SA, 2023).

This model has yielded tangible financial and operational outcomes. The early renewal of Rumo’s Malha Paulista in 2019 secured R\$ 4.6 billion in investments. Subsequent renewals for VLI’s section of the Ferrovia Norte-Sul and Rumo’s Malha Sul have committed billions more to projects like track-doubling, locomotive acquisitions, and yard expansions (ANTT, 2023b). These investments are crucial for alleviating bottlenecks and supporting the growing volume of agricultural and mineral exports.

However, a critical analysis reveals that this process does little to alter the fundamental dynamics limiting competition and diversification. The renewal contracts perpetuate the vertically integrated model, thereby reinforcing the market power of the incumbents. While contracts may pay lip service to “right of way” or “open access,” the practical implementation remains negligible. The share of total TKU accounted for by mutual traffic or third-party access consistently remains below 0.1% (ANTT, 2023a), demonstrating the effective impossibility for an independent operator to run trains on a concessionaire’s network. Moreover, the new projects funded by cross-investment, while adding capacity, largely reinforce the existing commodity-export paradigm. For instance, the FICO is explicitly designed to transport grains from Mato Grosso, not to serve a diversified range of shippers (see Table 3).

In essence, the early renewal process is an effective tool for capital intensification within the established system but falls short as an instrument for structural reform. It addresses the

Table 3. Selected early concession renewals and key features

Concession	Concessionaire	Year of renewal	Committed investment (billion R\$)	Key focus of investment
Malha Paulista	Rumo Logística	2019	4.6	Capacity increase for agricultural corridors (Midwest to Santos)
FNS Section 1	VLI Logística	2021	~3.0	Doubling of tracks, acquisition of rolling stock
Malha Sul	Rumo Logística	2022	~5.0	Expansion of capacity and modernization for grain transport
Example of Cross-Investment Project	Funding Source	Status	Estimated Value	Primary Cargo Focus
EF-354 (FICO)	Grant Fees from Renewals	Planning/ Auction	To be defined	Agricultural commodities (Mato Grosso)
Ferroanel (SP)	Grant Fees from Renewals	Planning	To be defined	Urban freight bypass, mixed cargo

Source(s): Compiled from ANTT (2023b) and INFRA SA (2023)

5.1 Structural barriers to entry and diversification

The structural barriers that constrain diversification and limit the emergence of new operators in the Brazilian freight railway system extend far beyond the visible issue of restricted access. They form a multidimensional set of economic, operational, informational, and strategic mechanisms that reinforce the dominance of vertically integrated incumbents and inhibit competitive dynamics. These mechanisms are well documented in the literature on network industries and industrial organization, and their manifestations in Brazil are consistent with patterns observed in other concentrated railway markets.

Economic and commercial barriers: Economic theory on vertically related markets shows that integrated firms may have both the ability and the incentive to engage in forms of foreclosure that disadvantage independent entrants (Rey & Tirole, 2007; Church & Ware, 2000). In the railway context, this can manifest through access charges, bundling practices, or contractual provisions that alter the relative cost structure faced by potential competitors. In Brazil, stakeholders frequently report that the absence of transparent and cost-based methodologies for track access pricing creates significant uncertainty for non-integrated operators. Unlike jurisdictions where regulators mandate ex-ante pricing frameworks and reference access contracts - as in the European Union’s Rail Access Directives - the Brazilian system delegates substantial discretion to incumbents, amplifying information asymmetries and strategic pricing behaviour.

Technical and operational barriers: Railway competition depends critically on the ability of entrants to secure reliable network access in terms of scheduling, dispatching, and operational coordination. Research on European regulatory reforms demonstrates how control over path allocation and train management can be used to discriminate, even subtly, against new operators (Nash & Rivera-Trujillo, 2004). The absence of a standardized, transparent capacity-allocation framework in Brazil - combined with vertically integrated control over traffic management systems - creates a structural asymmetry. Potential entrants face greater uncertainty regarding slot availability, schedule stability, and operational priority, conditions that diminish the commercial viability of competing services. These factors heighten entry risks even where physical capacity exists, functioning as de facto operational bottlenecks.

Informational and contractual barriers: Information asymmetries represent a significant source of competitive disadvantage in network industries. In many countries with open-access regimes, infrastructure managers are required to publish Network Statements detailing track characteristics, maintenance planning, capacity availability, and access procedures. Brazil lacks an equivalent comprehensive disclosure framework. As a result, prospective operators have limited visibility into infrastructure conditions, effective capacity constraints, performance metrics, or maintenance schedules. Additionally, standard contractual clauses governing access - such as liability provisions, minimum volume requirements, or exclusivity arrangements - may impose obligations incompatible with the scale or risk profile of new entrants. These features align with findings in the international literature showing how contractual design can entrench incumbent advantages even in the presence of nominally open-access rules (Cantos et al., 2012; Pittman, 2011).

Strategic withdrawal and underutilization of branch lines: A final structural barrier arises from the long-term underutilization or abandonment of secondary and branch lines. Although presented as outcomes of insufficient demand, these patterns often coincide with the strategic incentives of integrated operators to concentrate investments on high-density commodity corridors. The deterioration of branch infrastructure increases the cost and uncertainty associated with reactivation, thereby preempting the entry of independent short-line operators - actors that have played a pivotal role in revitalizing low-density rail segments in North America. International evidence shows that once deterioration reaches a threshold, the barriers

to reactivation become self-reinforcing, creating what [Pittman \(2011\)](#) describes as a “path-dependent lock-in” that shapes future market structure.

Taken together, these economic, operational, informational, and infrastructural barriers constitute a mutually reinforcing system that sustains Brazil’s concentrated railway structure. [Gual and Mas \(2011\)](#) describe this as a “vicious circle” for potential competitors: incumbents benefit from economies of scale, privileged information, and institutional control, while entrants face uncertainty, cost disadvantages, and limited access to viable routes. The early renewal of concessions, by failing to incorporate mechanisms to dismantle or mitigate these structural barriers, risks institutionalizing this equilibrium. As a result, the system evolves toward stable dominance by a few vertically integrated operators, with limited prospects for cargo diversification or meaningful intramodal competition.

6. Pathways to modernization: the new regulatory framework

Recognizing the limitations of the concession renewal path alone, Brazil introduced a potentially transformative piece of legislation: the new Legal Framework for Railways (Law 14.273/2021). This law introduces two alternative models designed to break the inertia of the existing system:

- (1) *Authorization Regime*: This model allows private entities to obtain a permit to build and operate new railway lines. It is a more flexible, less bureaucratic system than the traditional concession, offering operators freedom to set their own tariffs (subject to notification). This significantly lowers entry barriers for investors interested in specific projects, including those aimed at general cargo that were not commercially attractive under the large-scale concession model.
- (2) *Short-Line Railways*: The law explicitly promotes the development of shorter, feeder lines that connect to the main trunk networks. These short-lines are envisioned as the capillary system of the national logistics network, responsible for capturing dispersed cargo, serving regional industries, and potentially reactivating abandoned branches.

These models directly target the historical weaknesses of the Brazilian system. Short-lines, with their lower capital requirements, simpler engineering, and closer ties to local economic dynamics, are ideally suited to attract a new class of Independent Railway Operators (OFIs). They can perform the essential “first and last mile” functions that the major concessionaires have abandoned, collecting and distributing general cargo and feeding it into the high-capacity trunk lines. This creates the potential for a truly integrated and efficient national network, rather than a collection of isolated corridors.

The government, through INFRA S.A., is actively promoting these models, but international experience suggests that their success will depend on the strength and credibility of the accompanying regulatory framework. Open-access and short-line regimes require independent regulators capable of setting and enforcing transparent capacity-allocation procedures, cost-oriented and non-discriminatory access charges, and clear dispute-resolution mechanisms ([Casullo, 2016](#)). The Australian Hunter Valley coal network, for example, operates under a legally binding access undertaking overseen by the Australian Competition and Consumer Commission (ACCC), which specifies the obligations of the infrastructure manager towards access seekers and constrains the level and structure of access charges. Such arrangements offer useful benchmarks for designing Brazilian access rules that can reconcile the interests of incumbent concessionaires, new short-line operators and a more diverse community of freight users.

7. Discussion: bridging the gap between policy and outcomes

The diagnosis of the Brazilian railway sector is unequivocal. It is a system that excels in its niche but fails in its broader potential. The early renewal process has successfully fulfilled its

role as a catalyst for investment but has proven to be a blunt instrument for fostering competition and diversification. The persistence of the vertically integrated model in renewed contracts continues to grant incumbents the power to act as gatekeepers, and the theoretical right of way remains practically unimplemented.

For the railway to truly evolve into a tool for national integration and economic resilience, the renewal process and the new regulatory framework must be strategically and forcefully aligned. The mere existence of the authorization regime is not enough. Policymakers must use the leverage of concession renewal and the design of the new framework to actively create a more contestable market. Future renewal agreements and the implementation of the authorization regime should be conditioned on stronger, pro-competitive provisions.

International experience also highlights that some policy objectives cannot be achieved through commercial incentives alone. Non-profitable but socially desirable services – such as low-density branches serving regional industries or intermodal terminals in less developed areas – typically require explicit public service obligation (PSO) contracts or targeted subsidies, rather than implicit cross-subsidies embedded in vertically integrated concessions (Di Pietrantonio & Pelkmans, 2004; Tomeš, 2017). For Brazil, this implies that the reactivation of low-density branches and the expansion of general-cargo services may depend on well-designed PSO arrangements and transparent subsidy schemes, integrated into concession renewals and authorization contracts, rather than on the expectation that concessionaires will voluntarily serve these markets.

- (1) *Mandatory Capacity Allocation and “Open Access” Rules:* Trunk-line concessionaires should be required to publish a transparent schedule of available network capacity and to offer a defined, non-discriminatory share of it to independent operators under regulated conditions. This moves beyond vague “right of way” clauses to enforceable access obligations.
- (2) *Regulated Tariffs for Essential Infrastructure:* To prevent anti-competitive pricing, the access fees that a trunk-line concessionaire can charge an independent operator for using its tracks should be subject to regulatory oversight, based on principles of cost-orientation and non-discrimination.
- (3) *Active reactivation of branches:* Instead of allowing deactivated branches to remain idle or be formally returned to the state, a more proactive policy is needed. The regulator could mandate that concessionaires either reactivate these lines themselves or transfer them, under defined terms, to short-line operators, perhaps through a public bidding process.

Without such assertive, complementary measures, there is a significant risk that the new authorization model will simply lead to the creation of new, smaller dedicated lines for specific commodities or clients, replicating the current logic on a smaller scale. This would fail to create the genuinely open and competitive network necessary to attract general cargo. Consequently, Brazil’s damaging over-dependence on highways for its internal freight would persist, along with the associated economic costs and systemic vulnerabilities, as starkly demonstrated by the nationwide disruptions caused by the 2018 truckers’ strike.

7.1 International lessons and implementation pathways

International experience shows that successful railway reforms share a set of institutional and regulatory design features that help reconcile private investment incentives with broader public-interest objectives such as diversification, competition, and service coverage. Although the political, economic and territorial contexts vary widely across countries, several lessons from Europe, Australia and North America offer relevant insights for the Brazilian debate.

The European Union’s experience with progressive market opening illustrates the crucial role of institutional separation and transparent access governance in enabling intramodal

competition. While full vertical separation was mandated under Directive 91/440/EEC and subsequent railway packages, many member states adopted hybrid structures in which an independent or semi-independent infrastructure manager operates under strong regulatory oversight. Evidence from the United Kingdom, Germany and the Netherlands suggests that non-discriminatory access has been most credible where infrastructure managers publish detailed Network Statements, capacities, and pricing methodologies, enabling new entrants to plan operations with greater certainty (In Nash, Crozet, & Link, 2019; Crozet, 2017). Furthermore, ex-ante regulatory frameworks—such as the British Office of Rail and Road’s Network Code and Germany’s Trassenpreissystem—have limited scope for discretionary, opaque decision-making and reduced access-related disputes. Although the EU model requires significant administrative capacity and comes with higher transaction costs, it demonstrates that transparency and predictability are prerequisites for genuine contestability.

The Australian case provides an instructive example for commodity-dependent economies. The creation of the Australian Rail Track Corporation (ARTC) established a dedicated interstate infrastructure manager operating under a transparent, long-term access undertaking accepted by the Australian Competition and Consumer Commission (ACCC). This arrangement allowed vertically integrated operators to coexist with independent rail freight companies, while safeguarding non-discriminatory access to essential corridors. Australia’s National Access Regime, under Part IIIA of the Competition and Consumer Act 2010, also provides a mechanism for declaring “essential facilities” and mandating access when negotiations fail - a tool that could be adapted to Brazilian trunk corridors where competitive bottlenecks persist (Productivity Commission, 2017; ACCC, 2021). At the same time, Australia’s experience also demonstrates that access regulation alone is insufficient to stimulate competition in bulk mineral markets, where incumbents retain substantial advantages in asset specificity and economies of density (Wills-Johnson, 2020).

For the revitalization of branch lines and the emergence of short-line operators - both central pillars of Brazil’s current reform agenda - North American experience offers particularly relevant lessons. In the United States, over 600 short-line and regional railroads have revitalized nearly 50,000 miles of secondary track since the Staggers Rail Act of 1980 enabled more flexible leasing and divestiture of low-density lines. Factors behind this success include: simplified regulatory treatment for smaller operators, recognition of distinct cost structures; public-private partnerships leveraging federal funding programmes such as the Railroad Rehabilitation and Improvement Financing (RRIF) scheme; and innovative governance models including shipper cooperatives and community-owned railroads (AAR, 2022; Martland & Sussman, 2020). Brazil’s authorization regime and its nascent short-line initiatives could benefit from adopting a similar differentiated regulatory approach, calibrated to the economics of low-density lines rather than mirroring obligations designed for high-volume concessionaires.

A comparison of international regulatory models helps contextualize Brazil’s trajectory and highlights feasible pathways for reform. Table 4 contrasts the institutional arrangements of selected countries and summarizes their relevance for Brazil.

Across all these reform trajectories, the role of state capacity emerges as a decisive factor. Comparative research on infrastructure regulation shows that independent regulators with technical expertise, adequate resources, and political autonomy are essential for enforcing access rules, mediating disputes, and ensuring that private operators comply with contractual and public-service obligations (Jordana & Levi-Faur, 2004; Baldwin, Cave, & Lodge, 2011). Chile’s experience with highway and port concessions demonstrates that credible, technically capable regulators can effectively administer complex, long-term contracts while maintaining investor confidence (Bitran, Nieto-Parra, & Robledo, 2013). For Brazil, strengthening ANTT’s analytical capabilities, enforcement authority, and insulation from political cycles may therefore be as important as the legislative reforms embedded in Law 14.273/2021.

Drawing from these international experiences, a phased implementation strategy appears most appropriate for Brazil. In the short term (0–2 years), remaining concession renewals

Table 4. International regulatory models and relevance for Brazil

Country/ Region	Structural model	Key regulatory instruments	Outcomes	Relevance for Brazil
European Union	Vertical separation	Network Statements, regulated access pricing, independent regulator	Increased competition in some corridors; high transaction costs	Lessons for access transparency
Australia (ARTC)	Hybrid: independent infra manager + private operators	ACCC oversight; long-term access undertakings	Coexistence of miners + independents	Model for Brazilian trunk lines
United States	Vertically integrated, strong short-line ecosystem	Flexible leasing/ divestiture; federal financing	Revitalization of 50,000 km of branch lines	Benchmark for short-line development
India	Right-of-use model on state tracks	PPP concessions; regulated tariffs	Mixed success; rising competition	Relevant for shared-use corridors
South Africa	State monopoly, attempts at open access	Ongoing reforms	Persistent integration challenges	Cautionary example for Brazil

should require transparent publication of capacity, access procedures, and pricing methodologies on selected pilot corridors, enabling the gradual institutionalization of open-access practices. In the medium term (2–5 years), Brazil could experiment with establishing a dedicated infrastructure authority for the Norte-Sul and other strategic corridors, with access pricing based on long-run incremental cost methodologies similar to those used by ARTC. In the long term (5–10 years), a differentiated regulatory regime should be formalized, recognizing the distinct economic characteristics of trunk lines, regional corridors and low-density short lines, and aligning each category with tailored access, investment, and public-service obligations.

Taken together, these international lessons reinforce the notion that Brazil’s challenge is not merely to increase investment or introduce new regulatory instruments, but to build the institutional, informational and organizational conditions necessary for a genuinely diversified and competitive railway system. The experience of other jurisdictions suggests that such transformation is achievable but requires sequencing, coordination, and sustained regulatory commitment.

The pursuit of economic resilience demands a transport system that is not only efficient but also diversified, territorially integrated and environmentally sustainable. The Brazilian freight railway sector has already demonstrated its capacity to deliver efficiency gains when the institutional framework is clear and investment incentives are strong. The challenge now is to deploy equally robust instruments – such as enforceable open-access rules, credible PSO contracts and transparent authorization schemes – to reshape market structure and service patterns in favour of greater competition, wider cargo coverage and better utilization of the existing network.

8. Conclusion

This study offers a comprehensive and analytically grounded assessment of Brazil’s freight railway system at a decisive moment of institutional transformation. By integrating concepts from regulatory theory, institutional economics, and industrial organization, the analysis demonstrates that the mixed concession-renewal framework - although effective in mobilizing

investment and improving operational safety - has not addressed the structural determinants of market concentration, nor has it fostered the diversification necessary for a more competitive and socially efficient system. The persistence of vertically integrated monopolies, combined with limited contestability in trunk corridors and substantial underutilization of regional and branch lines, remains the core mechanism constraining the long-term performance of the sector.

The findings uncover a clear causal chain. The regulatory design embedded in early concession renewals strengthened incumbents' control over essential facilities, shaping a highly concentrated market structure that limits competitive dynamics. In turn, this structure discourages the development of diversified cargo profiles, amplifies dependency on bulk commodities, and perpetuates chronic underuse of significant portions of the national rail network. Improving system performance therefore requires reforms that explicitly break this causal loop, rather than incremental adjustments within the current institutional architecture.

International experience reinforces these conclusions. Countries that have successfully increased freight diversification - such as Australia with the ARTC model or European nations through more transparent open-access regimes - implemented reforms that simultaneously restructured access rules, clarified capacity allocation procedures, and strengthened the independence of regulatory bodies. These examples highlight that structural reforms in network industries require coherent institutional strategies capable of aligning incentives across infrastructure managers, operators, regulators, and users. While Brazil's context presents unique challenges, the pathways adopted abroad provide evidence-based guidance for the design of feasible and effective reforms.

Drawing from this comparative evidence, a phased implementation strategy emerges for Brazil. In the short term, reforms should prioritize transparent publication of network capacity, standardized access charging methodologies, and the activation of pilot corridors that enable competitive entry under clear procedural rules. In the medium term, establishing an independent infrastructure manager for strategic trunk corridors - beginning with the North-South axis - would reduce conflicts of interest, improve capacity allocation, and enhance the predictability required for new investments. Over the long term, Brazil should consolidate a differentiated regulatory regime for trunk lines, regional corridors, and low-density short lines, recognizing their distinct economic characteristics and aligning regulatory obligations with their respective viability conditions.

Beyond these policy implications, this study also highlights opportunities for future research. Further work should quantify the potential welfare gains associated with alternative access regimes, employ simulation and network modelling to evaluate impacts under different market structures, and generate case studies of early entrants operating under the new authorization model. Comparative analyses involving India, South Africa, China, and EU member states would also enrich the understanding of how institutional capacity, governance arrangements, and regulatory design interact to shape outcomes in emerging and mature economies alike.

Ultimately, Brazil's freight railway system stands at a critical crossroads. Without structural reforms capable of enhancing contestability, diversifying cargo flows, and enabling transparent and non-discriminatory access to infrastructure, the country risks perpetuating a model that generates private efficiencies but limited collective benefit. With coherent regulatory redesign, strengthened state capacity, and a long-term commitment to improving market structure, Brazil has the opportunity to transition toward a more dynamic, diversified, and internationally competitive railway system - one capable of delivering broader socio-economic benefits in line with its strategic national logistics ambitions.

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