



THE MISSING INSTITUTION IN EUROPEAN RAIL FREIGHT CORRIDOR GOVERNANCE: LESSONS FROM AVIATION AND ELECTRICITY

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Abstract – Recent research has shown that the application of cooperative game theory in European rail freight corridor governance, as a tool for enhancing cooperation among governments and infrastructure managers, can improve corridor performance and revenue generation through cooperative game solution concepts. However, the practical application of such a model depends on a critical institutional assumption: the existence of a governance body able to centrally collect track access charges or, at minimum, organize financial transfers between corridor participants. This paper addresses this institutional void. It examines the current governance structure of Rail Freight Corridors under Regulation (EU) No 913/2010 and argues that existing corridor bodies function primarily as coordination platforms rather than entities with fiscal authority. To identify a feasible path forward, the paper compares rail with electricity and aviation sectors, where these issues are already addressed. On this basis, it proposes a practical corridor-level institutional model capable of operationalizing cooperative revenue allocation, improving corridor performance, and strengthening the competitiveness of rail freight in the European transport market.

Keywords – railway corridors, electricity, aviation, governance, revenue allocation

1. INTRODUCTION

Rail freight corridors (RFCs) represent one of the clearest examples of the tension between the transnational logic of transport markets and the nationally bounded structure of infrastructure governance in Europe. Although international freight services operate across several countries as a single transport chain, the underlying infrastructure remains managed, priced, and financially accounted for by separate national infrastructure managers (IMs). Despite more than a decade of development, RFC governance bodies remain coordination platforms without financial competences. None of the existing corridor bodies is empowered to collect, settle, redistribute, or compensate corridor-related infrastructure charges. As a result, railway undertakings still face a system in which track access charges are paid separately to each IM along the route, while broader corridor objectives continue to depend largely on voluntary cooperation among participating states and IMs. This institutional asymmetry significantly constrains the capacity of RFCs to

function as integrated economic and governance spaces.

This paper builds directly on previous research by the same author(s), including the published cooperative game model in Prokić and Bošković (2025) and the broader analytical and empirical work developed in Prokić (2026). That research started from the premise that many of the persistent inefficiencies observed on international rail freight corridors stem from insufficient coordination and cooperation among governments and IMs along the corridor. On that basis, a cooperative game framework was developed and demonstrated, including on the Alpine–Western Balkan Rail Freight Corridor, showing that corridor-level cooperation may generate higher collective track access charges revenues than nationally optimized charging structures. By applying cooperative game theory, particularly the Shapley Value together with two corridor-specific solution concepts, the model provided a mathematical basis for allocating the gains from cooperation among corridor participants [1], [2].

The significance of that earlier work is twofold.

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First, it demonstrated that corridor-level cooperation is not only normatively desirable but can also be economically rational. Second, it showed that RFCs may be understood not merely as platforms for coordination, but as potential spaces of joint economic governance in which performance improvements and revenue gains can be distributed according to transparent rules. However, that same research also revealed a decisive institutional limitation: cooperative revenue allocation cannot be implemented without a mechanism capable of collecting payments, calculating entitlements, and arranging financial transfers among participating IMs. Such a mechanism is currently absent from RFC governance.

This is the central problem addressed in the present paper. While the economic and mathematical foundations of corridor-level cooperation have already been established, the institutional framework required to operationalize them is still missing. Regulation (EU) No 913/2010 created a framework for coordination, capacity-related cooperation, and stakeholder consultation, but it did not establish a corridor-level fiscal or settlement mechanism. In this respect, the existing institutional design is not merely incomplete, it is structurally incapable of implementing cooperative revenue allocation in practice [3].

To assess whether such an institutional arrangement could be developed in the railway sector, this paper turns to other European network industries characterized by transnational flows and nationally organized infrastructure. Electricity and aviation provide particularly relevant points of comparison because, in both sectors, the growth of cross-border flows led to institutional mechanisms extending beyond coordination alone to include charging, compensation, and revenue redistribution. This broader question is not absent from European railway policy debates. The European Union Agency for Railways has already raised the idea of a “Eurocontrol for rail,” pointing to the need for stronger pan-European institutional capacity in traffic management, path allocation, and cost recovery [4].

Against this background, the present paper asks what kind of institutional design would be required to operate cooperative revenue allocation in European rail freight corridors. More specifically, it examines whether the experience of the electricity and aviation sectors can inform the creation of a rail-specific body or department capable of supporting centralized track access charge collection and redistribution. The contribution of the paper is therefore not to propose a new mathematical allocation rule, but to shift the debate from allocation theory to institutional design. The central question is no longer only how the cooperation surplus should be divided, but which

institution should have the authority and capacity to collect, manage, and redistribute it.

2. STATE OF PLAY IN EUROPEAN ELECTRICITY SECTOR

The electricity sector provides a particularly relevant institutional analogy for RFCs because it combines cross-border flows with nationally organized infrastructure management. Like the railway sector, it underwent liberalization and structural reform, through which vertically integrated national monopolies were unbundled and infrastructure management was separated from competitive market activities. In that process, Transmission System Operators (TSOs) emerged as the entities responsible for operating, maintaining, and developing the high-voltage transmission grid, in a role broadly comparable to that of IMs in the railway sector [5], [6]. This parallel is important because in both sectors infrastructure remains nationally organized, while system use increasingly acquires a transnational character. As cross-border electricity trade expanded, the physical and economic interdependence of national grids became increasingly difficult to manage through domestic institutions alone. Nationally optimal decisions often diverged from what would be optimal at the European level, particularly in areas such as system operation, investment planning, and tariff design [7]. In response, the European Union progressively developed a multi-level governance framework capable of reconciling national competences with broader system objectives. At the European level, the Agency for the Cooperation of Energy Regulators (ACER) was established to strengthen coordination among national regulators and reduce the risk of fragmentation within the internal energy market [7]. [8]. At the level of infrastructure management, the European Network of Transmission System Operators for Electricity (ENTSO-E) was established in 2009 as a supranational, not-for-profit association representing TSOs across Europe and providing a common institutional platform for cooperation in network planning, market integration, adequacy assessment, technical standard-setting, and the development of shared tools and data platforms [5], [9]. A particularly important lesson for the railway sector lies in the evolution of regional cooperation in electricity. Initially, coordination among TSOs was largely voluntary and took place through joint offices and technical coordination centres. Over time, however, it became evident that voluntary cooperation was not sufficient to sustain an increasingly integrated market and to safeguard cross-border system performance. This led first to the creation of Regional Security Coordinators and later, with a stronger legal basis, to

the establishment of mandatory Regional Coordination Centres from July 2022 onward [10]. In other words, what began as voluntary cooperation gradually evolved into a more formalized and partly mandatory structure, supported by supranational institutions and clearer European rules. This institutional trajectory is highly relevant for RFCs, where cooperation remains predominantly voluntary and where corridor governance bodies still lack the authority and instruments needed to ensure effective collective action. Another key feature of the electricity sector, and one largely absent from the railway sector, is the existence of a European-level mechanism for charging and compensating transit flows. As the internal electricity market developed, traditional transit charges became increasingly problematic because they led to tariff pancaking, that is, the accumulation of multiple transmission charges as electricity transactions crossed several national borders. This created a barrier to efficient cross-border trade because charges reflected the number of jurisdictions crossed rather than the logic of an integrated network. In response, the sector moved toward the so-called single system paradigm, under which the European electricity network would increasingly be treated, for tariff purposes, as if it were one integrated system rather than a sequence of separate national systems [11]. The abolition of separate transit charges, however, immediately created a redistribution problem. TSOs hosting cross-border flows continued to bear transmission losses and infrastructure-related costs, but they could no longer recover those costs through national transit tariffs. The response was the creation of the Inter-Transmission System Operator Compensation (ITC) mechanism, first introduced in 2002 and subsequently formalized in European legislation, notably Regulation 714/2009 and Commission Regulation 838/2010 [11], [12]. Rather than establishing a single pan-European transmission tariff, the parties opted for a compensation mechanism covering both the use of external networks and the losses generated by cross-border transactions and loop flows [13]. Today, the ITC mechanism forms part of Europe's broader electricity infrastructure cost-sharing framework. It compensates TSOs for the costs of hosting cross-border transit flows, including transmission losses and infrastructure availability costs. The mechanism is financed through the ITC Fund, with participating TSOs or groups of TSOs receiving compensation according to the transits they carry and contributing to the fund on the basis of their net imports and exports. Its implementation and clearing are carried out by ENTSO-E under the ITC Clearing and Settlement Multi-Year Agreement, while ACER oversees implementation and reports annually to the European

Commission on the functioning of the mechanism and the management of the fund [14].

3. STATE OF PLAY IN EUROPEAN AVIATION SECTOR

Since the 1950s, the rapid expansion of civil aviation, driven in particular by the introduction of jet aircraft, has led to a substantial increase in air traffic volumes and, consequently, to a significant rise in the complexity of air traffic management. This development required European countries to invest in increasingly advanced automated systems, while the costs of providing air navigation services grew considerably. At the same time, countries became aware that, with the expansion of international civil aviation, they were effectively providing services free of charge to airlines from other countries unless a common charging framework was established.

It was in this context that the European Organisation for the Safety of Air Navigation (Eurocontrol) was founded in 1960. The original Member States decided to adopt a common policy for en-route charging, establish a joint system for the calculation, billing, and collection of en-route charges, and entrust Eurocontrol with the administration of this system. This institutional development led to the establishment of the Central Route Charges Office (CRCO) in 1971, which became responsible for operating a centralized system for the collection of route charges. In essence, aircraft operators are charged for the use of airspace in order to contribute to the costs incurred by countries and air navigation service providers in the provision of en-route services. Within the Eurocontrol area, a harmonized route charging system was thus developed, under which the CRCO is responsible for billing, collecting, and disbursing route charges to Member States. Eurocontrol also provides similar services for terminal navigation charges, communication charges, and certain charging functions for non-Member States under the relevant legal arrangements [15], [16].

From an institutional perspective, this is highly significant. Eurocontrol was not established merely as a coordination forum, but as an organization with operational and financial functions at supranational level. Its broader objective has been to promote the development of a seamless pan-European air traffic management system and to harmonize strategies in the field of air traffic management while preserving safety. A key legal foundation of this system is the Multilateral Agreement relating to Route Charges, signed in 1981, under which the Contracting States agreed to adopt a common policy and create a joint system for the calculation, billing, and recovery of route charges, using Eurocontrol for this purpose [17]. Through the CRCO, Eurocontrol bills and collects en-

route charges on behalf of its Member States, thereby performing precisely the type of centralized financial function that is missing in the governance of European rail freight corridors.

The relevance of the aviation sector was further reinforced by the evolution of EU law. On 6 December 2006, the European Commission adopted Regulation (EC) No 1794/2006, laying down a common charging scheme for air navigation services, applicable from 1 January 2007. This Regulation was fully consistent with the Eurocontrol Multilateral Agreement, but at the same time constituted an important step in the implementation of the Single European Sky. Its purpose was not only to strengthen enforcement of the existing route charging system, but also to further harmonize air navigation service charges across European airspace. According to the European Commission's objectives, the system was intended to ensure that charges were fair, transparent, and reflective of the real costs of services, while also encouraging the safe and efficient provision of air navigation services and strengthening consultation mechanisms with airspace users [17].

The operational logic of the route charging system is relatively straightforward. A route charge is levied for each flight performed within Eurocontrol airspace, which is divided into charging zones defined by the Member States. The charge is calculated on the basis of three core elements: the distance factor for each charging zone, the aircraft weight factor, and the unit rate of charge applicable in the respective charging zone [18].

The system is based on the principle of full cost recovery. Forecast data are used to define the annual unit rates for each charging zone, with the unit rate expressed in euro and calculated as the ratio between the forecast en-route cost base of the charging zone and the forecast number of service units for the same period, plus an administrative fee applied uniformly

across zones in order to cover the costs of the CRCO. The unit rates are defined annually by each Member State and, where relevant, adjusted monthly when national currencies other than the euro are involved [19].

This charging architecture is especially relevant for the argument of the present paper because it clearly separates service provision from financial administration. Air navigation services remain provided by national or designated Air Navigation Service Providers (ANSPs), but the financial interface with airlines is centralized through Eurocontrol. This means that an airspace user does not need to pay each provider separately for each segment of a multi-country flight. Instead, the CRCO performs the functions of centralized calculation, billing, collection, and disbursement. In institutional terms, Eurocontrol acts as the "banker" of the system.

4. COMPARISON BETWEEN SECTORS

The comparison with the electricity and aviation sectors shows that cross-border infrastructure systems can be supported by institutions that perform not only coordination functions, but also financial settlement functions.

In the electricity sector, cross-border use is addressed through a compensation mechanism between network operators, whereas in aviation Eurocontrol provides centralized billing, collection, and redistribution of charges.

RFCs currently have neither of these arrangements. They lack both a formal clearing mechanism between IMs and a centralized body able to collect and redistribute revenues across jurisdictions.

The main institutional differences among the three sectors are summarized in Table 1.

Tab 1. Comparative institutional features of railway, electricity, and aviation

Dimension	Rail Freight Corridors (current model)	Electricity sector	Aviation sector
Nature of network use	International freight trains use infrastructure across several countries	Cross-border electricity flows pass through several national grids	Flights use airspace and air navigation services across multiple countries
Infrastructure operators	National infrastructure managers	Transmission System Operators	National or designated Air Navigation Service Providers
Current charging relationship with user	Railway undertaking pays each infrastructure manager separately along the train path	Network users are not charged through a fully corridor-like central mechanism, but TSOs are compensated for hosting cross-border flows	Airlines receive a centralized bill through Eurocontrol's CRCO
Cross-border coordination structure	Executive Board, Management Board, C-OSS, advisory groups	ACER, ENTSO-E, RCCs, national regulators	Eurocontrol's CRCO and other relevant departments
Degree of	Limited, mostly coordination-	Strong coordination and	Strong coordination plus

supranational coordination	based	compensation framework	centralized financial administration
Financial settlement mechanism	No centralized TAC collection or redistribution body	ITC mechanism compensates TSOs for hosting cross-border flows	CRCO centrally bills, collects, and redistributes route charges
Legal basis for cross-border financial mechanism	No dedicated supranational fiscal mechanism under RFC governance	EU legislation and regulatory framework formalizing ITC	Multilateral Agreement relating to Route Charges and related EU legislation
Main institutional function	Capacity coordination and stakeholder consultation	Compensation for transit-related infrastructure and loss costs	Centralized calculation, billing, collection, and disbursement
Closest relevance for rail	Baseline problem: fragmented charging along one train path	Model for side-payments and compensation between infrastructure operators	Model for single billing and centralized redistribution
Main lesson for rail	Current model lacks a corridor-level financial institution and mandatory cooperation and coordination principle	Cooperation can be supported through an inter-operator compensation mechanism with mandatory cooperation principle on the regional level	A supranational body can lawfully act as the financial intermediary for a transnational network

5. PROPOSED INSTITUTIONAL FRAMEWORK FOR RFCS

The comparative analysis suggests that the main institutional lesson for RFCs is not the need to replicate the electricity or aviation sectors in full, but rather to recognize that supranational bodies can be created to guide decision-making beyond purely national priorities, organize cross-border financial flows, and support common charging principles at network level. In both comparator sectors, the existence of a supranational institutional layer has made it possible to align operational and financial arrangements with broader system objectives. For RFCs, this points to the need for a corridor-level institutional framework that combines strategic coordination, charging oversight, and financial settlement.

Accordingly, the most appropriate solution would be the establishment of a RFC's Settlement and Charging Department within each corridor governance body, with clearly defined corridor-level competences (Fig. 1). As illustrated in the figure, the idea is that every corridor governance body should include a dedicated department responsible for these functions. Such a reform would require either a new regulatory instrument or an amendment to Regulation (EU) No 913/2010, through which the purpose, competences, minimum institutional capacities, and governance arrangements of this department would be clearly defined.

Its role would be to ensure that the transnational use of corridor infrastructure is governed not only through the coordination of capacity and operational planning, but also through a structured framework for charging, collection, and revenue redistribution. In this respect, such a department would constitute the

missing institutional layer between nationally organized infrastructure managers and the transnational economic logic of corridor traffic.

The proposed department should perform three interconnected functions. First, it should provide a common corridor-level framework for determining access charge principles, including guidelines that would orient national charging practices toward corridor-wide objectives rather than purely national priorities. This would not necessarily imply the immediate full harmonization of track access charges across all participating countries, but it would require a supranational framework capable of defining common principles, reducing distortions, and increasing transparency in the treatment of corridor traffic. In this way, the department would help guide decision-making toward broader system goals, including improved corridor performance, more efficient use of infrastructure, and stronger rail freight competitiveness.

Second, the department should perform a central financial settlement function. Instead of maintaining the current fragmented structure in which railway undertakings pay each infrastructure manager separately along the train path, the corridor framework should enable centralized collection of access charges for corridor traffic and the subsequent redistribution of revenues among participating infrastructure managers according to an agreed methodology. The comparative experience of Eurocontrol demonstrates that such centralized collection is institutionally feasible in a transnational network industry, while the electricity sector shows that common clearing and settlement arrangements can be organized even in institutionally fragmented systems. For RFCs, this would create a much closer alignment between the

operational unity of a corridor train path and its financial treatment.

Third, the proposed department should ensure regulatory oversight, transparency, and compliance. Its role would therefore extend beyond financial intermediation alone.

charges is institutionally feasible, and that common guidelines for determining charges can be defined at corridor level.

For the railway sector, the central challenge is therefore not whether such an arrangement is conceptually possible, but how to provide it with an appropriate legal mandate and political support within the European railway...

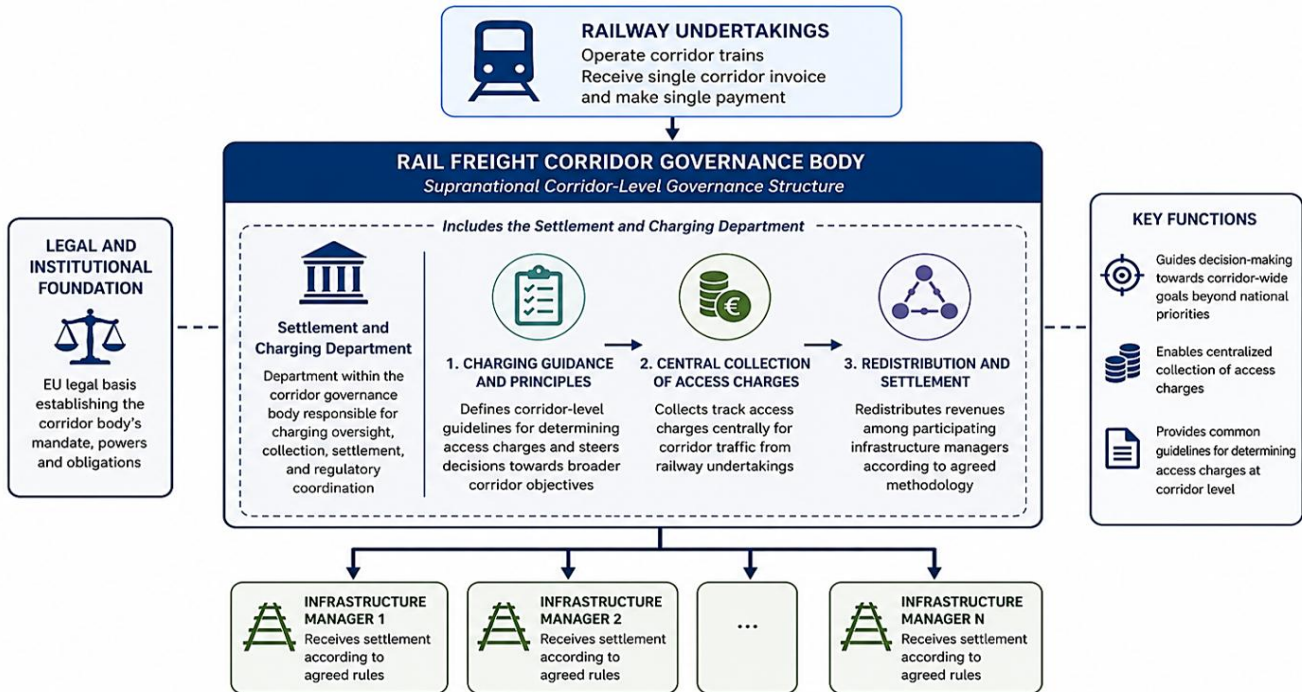


Fig 1. Proposed institutional framework for European Rail Freight Corridors

It should also provide the institutional safeguards necessary to ensure that the charging and redistribution process is transparent, predictable, and credible for railway undertakings, infrastructure managers, and governments. This would require clearly defined governance rules, operator participation, common reporting standards, and a legal basis capable of ensuring the enforceability of decisions and settlements at corridor level.

Under such a framework, the corridor would no longer function merely as a coordination platform. It would become an institutional space in which broader transnational objectives could be translated into concrete financial and regulatory practice. The proposed department would not replace infrastructure managers as owners and operators of national network segments. Rather, it would complement them by performing those functions that cannot be effectively carried out within purely national frameworks.

In this sense, the proposed institutional framework adapts the main insights derived from the electricity and aviation sectors to the specific realities of RFCs, namely that supranational bodies can legitimately steer decision-making toward broader network objectives, that centralized collection of access

governance framework.

6. CONCLUSION

The paper proposes that each RFC governance body should include a dedicated Settlement and Charging Department with corridor-level competences. Such a department would provide three essential functions: guidance on corridor-level charging principles, centralized collection and redistribution of access charges, and oversight of transparency and compliance. In this way, it would fill the current gap between nationally organized infrastructure management and the transnational economic logic of corridor traffic. Rather than replacing national IMs, it would complement them by performing those functions that cannot be effectively carried out within purely national frameworks.

The comparative analysis shows that this type of institutional reform is both necessary and feasible. The aviation sector provides the closest institutional analogy to the problem addressed in this paper. Eurocontrol and its CRCO demonstrate that, in a transnational network industry, a supranational

body can centralize billing, collection, and redistribution of charges while leaving service provision in the hands of national operators. For RFCs, this is the most relevant precedent, since it shows that a corridor-level financial function can be separated from the underlying management of national infrastructure. The electricity sector is relevant in a complementary but important sense. Namely, it shows that even in institutionally fragmented systems, financial compensation and settlement between national infrastructure managers can be organized through common rules, supranational coordination, regulatory oversight, and, crucially, a transition from voluntary to mandatory forms of regional cooperation. Unlike RFCs, where cooperation remains largely voluntary, the electricity sector demonstrates that effective cross-border governance ultimately required mandatory regional cooperation supported by a supranational institutional framework. Together, these examples confirm that strengthening RFC governance does not require a complete transfer of national competences, but rather the creation of a corridor-level institutional layer capable of aligning national actors with broader corridor objectives.

The central conclusion is therefore that the next step in the evolution of RFCs must be institutional rather than mathematical or purely economic. The key challenge is no longer only how to define a fair allocation of the gains from cooperation, but how to create an institutional framework capable of implementing it. In this respect, the proposed reform is not simply a technical adjustment to charging practices, but a broader governance reform aimed at strengthening the capacity of RFCs to function as effective transnational policy and management spaces.

If RFCs are to move beyond their current role as coordination platforms, they require an institutional mechanism able to connect operational coordination with financial settlement and strategic corridor-level objectives. A Settlement and Charging Department within each corridor governance body would provide precisely this missing link. Its establishment would strengthen RFC governance by reducing fragmentation, supporting more coherent charging practices, and creating the conditions for more effective, transparent, and competitive rail freight corridors in Europe. At the same time, such a framework would enable the gradual development of market-based allocation mechanisms, clearer allocation rules, and corridor-level guidance for the introduction and evolution of corridor access charges. In this way, institutional reform would not only improve the governance of RFCs, but also create the foundations for a more integrated and

economically consistent system of corridor management. The ongoing integration of RFCs into the broader European Transport Corridors framework may provide an additional opportunity for introducing such corridor-level financial functions in future governance reforms.

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