Financing High Speed Rail Infrastructure

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At the European and international level, the development of high-speed rail is among the main priorities. However, the substantial investment required for such large-scale infrastructure projects cannot be expected to be fully financed by governments alone. Therefore, a more comprehensive understanding of financing options and models is pivotal in this context. This issue of Network Industries Quarterly explores diverse financing models available for rail infrastructure and examines how policymakers can balance risk, capital mobilisation and long-term sustainability. Michele Gesualdi's contribution, entitled 'Financing High-Speed Rail: Models, Trade-offs and the Path to Bankability', shares that there is no single financing model for high-speed rail, with public delivery, PPPs and regulated asset base frameworks each suited to different institutional and fiscal contexts. Carbon finance emerges as a funding tool, and political commitment remains the key determinant of whether projects are delivered in an efficient, sustainable and fair manner. In his contribution, entitled 'Learning to Share Risk: Lessons from PPPs in High-Speed Rail', Prof. Juan Montero explains that after three decades of experience, high-speed rail PPPs have proven viable not by maximising risk transfer but by allocating risks to the parties best able to manage them. The public sector retains systemic risks and provides substantial support while private partners deliver construction and operational performance, even if at a higher financing cost than public procurement. Last, Russell Pittman, in his piece entitled 'Financing Freight Railway Infrastructure: An Underappreciated Third Option?', explains that the "competitive rules joint venture" model offers a potentially low-risk, scalable approach to rail reform that combines the European model's intramodal competition and access charging with the Americas model's reliance on private infrastructure investment, thereby providing both shipper choice and a sustainable source of capital.

Editors of this issue:

Juan Montero & Elodie Petrozziello

dossier

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Publication director | Matthias Finger

Managing editor | Juan Montero & Elodie Petrozziello

Publishing editor | Ozan Barış Süt

Founding editor | Matthias Finger

Publisher | Florence School of Regulation, Transport Area, Via Giovanni Boccaccio 121, 50133, Florence, Italy, phone: +39 055 4685 795, email: FSR.Transport@eui.eu and Istanbul Center for Regulation, Istanbul Technical University, Taşkışla, 34367 Istanbul, Turkey, email: info@ic4r.net

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Financing High-Speed Rail: Models, Trade-offs and the Path to Bankability

Michele Gesualdi, Senior Advisor High-Speed Rail, International Union of Railways (UIC)

Introduction

High-speed rail occupies a singular position in the infrastructure policy debate. It is simultaneously one of the most capital-intensive investments a government can undertake and one of the most strategically compelling: it reduces carbon emissions, improves territorial connectivity and stimulates economic activity across generations. Yet it is also one of the most financially demanding asset classes in existence, characterised by extreme upfront costs, decade-long negative cash-flow periods, inherently uncertain demand and revenue streams that are structurally capped by regulation or political constraint.

This contribution draws on the findings of the International Union of Railways (UIC)/Florence School of Regulation (FSR) report Financial Models for High-Speed Rail Infrastructure, produced with contributions by ADIF, DB, FSI and SNCF. Considering around 20 international projects in Europe, Asia and the Americas, the report examines the three main financial models that governments have deployed or are considering for high-speed rail: public delivery, public-private partnerships (PPPs) and a regulated asset base (RAB) governance framework. It complements its analysis with a discussion of the emerging role of carbon finance, a structural funding lever that is often overlooked in technical financing debates but is increasingly central in any realistic assessment of high-speed rail bankability.

The choice between these models depends on the institutional context, fiscal conditions and the maturity of the project. This contribution examines each in turn, drawing on international evidence to identify the conditions under which each performs and the trade-offs that decision-makers must navigate.

Why High-Speed Rail Is Financially Exceptional

Any serious discussion of high-speed rail financing must start with the structural characteristics that make this sector unlike almost any other infrastructure asset class.

Construction costs are very high: international data puts the global average unit cost at approximately EUR 45.5 million per kilometre (2022 prices). This average, however, masks very significant variation: costs can run considerably higher in challenging urban environments and tunnelled sections, and considerably lower in countries with mature procurement ecosystems and favourable topography, with Spain being a well-documented example of below-average unit costs. A standard greenfield corridor of 400 to 500 kilometres will therefore require a capital outlay in the range EUR 18 to 25 billion before a single service operates.

These costs are front-loaded in the extreme. Planning alone can take five years or more; construction adds another five or six. During this entire period, cash inflows are zero. Demand then ramps up gradually over four to six years after opening, before reaching a stable operational equilibrium. Negative cash flows can thus persist for more than a decade from project inception. No other mainstream infrastructure sector combines this degree of capital concentration with this length of zero-revenue exposure.

Revenue conditions compound the challenge. In the European Union, track access charges are regulated at or near directly incurred costs rather than full lifecycle costs (Directive 2012/34/EU). In practice, they cover as little as 3 percent of total project costs in countries such as Sweden and Czechia, and rarely exceed 50 percent even in Spain, where coverage is among the highest in Europe. Elsewhere, passenger fares face political and regulatory caps that limit revenue recovery. The implication is clear: in most high-speed rail markets, public subsidy will always be necessary to bridge the funding gap.

Add to this a range of systemic risks, including traffic forecasts that have historically been over-optimistic, construction cost overruns endemic in large infrastructure, political instability disrupting multi-decade commitments and regulatory uncertainty surrounding both access charges and fares, and the financial case for a carefully designed institutional architecture becomes overwhelming.

Public Delivery: The Benchmark, Not the Default

Public delivery remains the most common model for high-speed rail worldwide, and its dominance reflects structural rather than incidental reasons. Sovereign or quasi-sovereign borrowing commands the lowest cost of

capital: current indicative 10-year government bond yields range from under 2 percent (China) to around 3.5 percent (France, Spain, Italy) and above 4 percent (USA). Given that financing costs represent a substantial share of high-speed rail lifecycle costs, even a 100-basis-point differential, compounded over 30 years on a multi-billion-euro project, translates into enormous additional expenditure.

Beyond the cost of capital, governments are uniquely positioned to absorb the types of risk that high-speed rail generates: intergenerational investment horizons, political risk across electoral cycles and internalisation of economic and environmental externalities that markets cannot price. The historical record is consistent. Japan's Shinkansen (1964), France's TGV (1981), Spain's AVE (1992), Italy's AV network and China's extraordinary network expansion since 2008 were all built under public delivery models.

Public delivery is not without its own vulnerabilities, however. The most significant is the stop-and-go effect: when annual budgeting cycles collide with decade-long project timelines, funding starts, stalls and restarts. Portugal suspended signed contracts during the 2010-12 financial crisis. Each interruption adds cost, extends timelines and erodes contractor capacity and institutional knowledge.

Reinforcing public delivery therefore requires instruments that extend funding certainty beyond annual budget horizons. Three mechanisms stand out. First, dedicated transport or rail infrastructure funds with earmarked revenue: the Swiss Rail Infrastructure Fund is the clearest European example, providing multi-year visibility insulated from annual budget pressures and partly funded with heavy vehicle charges. France's AFITF operates on a similar logic. Second, multi-year funding frameworks that commit governments to investment envelopes of 10 to 20 years. Third, corporate finance by state-owned infrastructure managers: entities such as ADIF AV in Spain and RFI in Italy have raised substantial capital through loans and bond issuance, including green bonds supported by regulated revenue.

PPP: A Fiscal Bridge, Not a Cost Reducer

PPPs have been applied selectively in high-speed rail as a targeted complement to public delivery, primarily when sovereign fiscal constraints make it politically impossible to finance projects through the balance sheet of the state or its infrastructure managers. The contractual model, typically design-build-finance-operate over 20 to 50 years, provides a mechanism for deferring upfront public expenditure and, with certain accounting treatments, keeping liabilities off the public balance sheet.

The financial cost of this mechanism is substantial and well-documented. Private capital commands a significant premium over sovereign borrowing. Indicative weighted average cost of capital spreads for availability-based PPPs range from 200 to 375 basis points above sovereign rates; traffic-based PPPs attract even higher premiums. For a large high-speed rail project over a 30-year period, this spread translates into a significant addition to total present-value cost. Proponents argue that this premium is offset by efficiency gains from private sector discipline, lifecycle optimisation and performance incentives. The empirical record in high-speed rail is mixed. Major traffic-based PPPs, including the Channel Tunnel, HSL Zuid in the Netherlands, Perpignan-Figueras and Taipei-Kaohsiung, all experienced severe financial difficulties driven by demand shortfalls. Renegotiations, public bailouts and contract restructurings have been the norm rather than the exception.

The lesson drawn from this experience has been clear: traffic risk does not belong with private partners in high-speed rail. Availability-based PPPs have proven far more resilient, and more recent projects in Portugal and Czechia both reflect this evolution. But even in availability-based structures, value-for-money must be rigorously demonstrated: if the efficiency gains do not cover the financing premium, the PPP adds cost without adding capability.

The principal contribution of PPPs in high-speed rail is often not cost reduction but project enablement: they allow projects to proceed that would otherwise wait indefinitely for fiscal space to open. In contexts of genuine sovereign fiscal constraint, where PPP is not a preference but the only viable pathway to mobilise capital, this enabling function can represent substantial positive value at the system level, even if the lifetime financial cost of the individual project is higher than under public delivery. This dynamic is particularly pronounced in developing and emerging economies, where limited access to public debt markets or binding fiscal rules can make the PPP structure the practical precondition for any high-speed rail investment at all.

The conditions for a well-functioning PPP in high-speed rail are demanding. Planning must be sufficiently mature before financial close, with corridor definition, permitting and alignment resolved, so that private partners can price construction risk with confidence. Contract design must

include structured amendment mechanisms from the outset. Projects spanning 30 to 50 years will inevitably face changed circumstances, and rigid contracts without adaptation pathways tend to generate the renegotiation failures that have characterised the sector's worst PPP outcomes.

The Regulated Asset Base: A Governance Framework, Not a Financing Instrument

It is important to be precise about what the regulated asset base model is. It is fundamentally a governance and regulatory framework, not a financing instrument in itself. Rather than concentrating risk and certainty in a single long-term contract, it establishes a regulatory regime under which an independent regulator periodically determines allowed revenue based on efficiently incurred capital and operating expenditure, plus a fair return on invested capital. Investor certainty derives from the stability and credibility of the regulatory regime. The framework draws on a long track record in network utilities, covering electricity transmission, water, airports and air traffic control.

The financial implications of adopting this framework are significant. Evidence from utility sectors and selected transport applications shows that RAB-regulated infrastructure achieves a cost of capital only marginally above sovereign rates, with indicative spreads of 25 to 100 basis points compared to 200 or more for PPPs. The difference is structural. The RAB model pools regulatory risk across an entire asset base and across multiple periodic reviews, whereas a PPP concentrates project-specific risk in a single bilateral contract. The resulting risk profile, stable, inflation-linked and long-duration, is precisely what long-term institutional investors such as pension funds, sovereign wealth funds and insurance companies seek.

The RAB governance framework also provides advantages beyond financing cost. It can adapt to changing circumstances with regulatory reviews rather than costly contract renegotiations. It is inherently modular: a government can begin with a project RAB for a single corridor and expand the framework over time as institutional capacity and regulatory credibility develop. In the European context, EU legislation on vertical separation already creates the institutional foundation on which such a framework can be built. The European Commission's explicit reference to RAB as a potential financing approach in the HSR Master Plan discussions signals growing policy recognition of this pathway.

The prerequisites remain demanding. A credible, technically expert and politically independent regulator is essential. Without it, the commitment value of the framework collapses. Statutory protection for investor returns across political cycles is required. Rigorous ex-ante benchmarking of capital costs must prevent gold-plating of the asset base. These are not trivial requirements, but they are precisely the institutional investments that make long-term, low-cost infrastructure finance possible.

A Third Pocket: Carbon Finance as a Structural Lever

The three models described above address how to structure and allocate financing. They do not, on their own, close the fundamental funding gap that high-speed rail creates. Two pockets have always financed high-speed rail: taxpayers and users. The financing model shapes how the burden is split and the timing of payments, but it does not eliminate the underlying structural need for public subsidy. The question is whether a third pocket can meaningfully reduce this burden.

Carbon finance offers a structurally compelling answer. High-speed rail generates significant avoided emissions through modal shift from aviation and road transport. Depending on the carbon price level and the degree of modal substitution assumed, the present-value contribution of monetised avoided CO2 is material rather than marginal. At reference carbon price levels within the current EU ETS range, it can cover a structurally significant share of capital expenditure, and the contribution grows further at higher price levels. Even conservative assumptions, including lower modal substitution rates and partial monetisation, yield a structural contribution that meaningfully reduces the required level of public support under any of the three delivery models.

This contribution does not require a new institution or a new instrument. The EU ETS already generates revenue of approximately EUR 38 billion per year (2024 figure), with EU ETS 2 adding further volume from 2027. The Social Climate Fund already commits to supporting zero- and low-emission mobility. High-speed rail on medium-distance routes directly qualifies under this objective. The 2026 ETS review offers a timely occasion to consider how climate finance and high-speed rail investment might be more explicitly aligned. Building that case is as much a policy communication challenge as it is a technical one.

Conclusions

The UIC/FSR report on Financial Models for High-Speed Rail Infrastructure arrives at a conclusion that resists simplification: no single model is dominant. Each of the three frameworks examined has a legitimate role in the financing toolkit, and each performs better under specific institutional and economic conditions.

Public delivery remains the benchmark. It offers the lowest cost of capital and the best alignment with the intergenerational nature of high-speed rail investment, but it requires institutional instruments, including rail funds, corporate finance and multi-year frameworks, to insulate projects from short-term fiscal and political volatility.

PPPs have a place in this toolkit, but a narrow one. Where sovereign fiscal constraints genuinely prevent projects from proceeding, availability-based PPPs can enable investments that would otherwise not happen. Their value is as a fiscal bridge. The financing premium is real and persistent, and the conditions for success are demanding.

The RAB governance framework offers a credible middle ground: a lower cost of capital than PPPs, greater flexibility than long-term contracts and a modular design that allows progressive implementation. Its adoption requires investment in regulatory institutional capacity, but the incentive structure is clear.

In all three models, carbon finance is not a marginal complement. It is a structural component of the funding architecture. Activating this lever is a policy decision, not a technical one, and the European institutional framework to do so already exists. The EU High-Speed Rail Master Plan is an opportunity to set the framework conditions that make all these instruments available simultaneously. The financing model does not determine whether high-speed rail can be built. Political will does. But it determines whether it can be built efficiently, sustainably and at a cost that future generations will consider fair.

Learning to Share Risk: Lessons From Ppps in High-Speed Rail

Juan Montero, Director, Transport Area, Florence School of Regulation

Introduction

Public-Private Partnerships (PPPs) in high-speed rail have a difficult reputation. The first generation produced some of the most visible infrastructure restructurings of the last thirty years: the Channel Tunnel, HS1, Taiwan High Speed Rail and the Perpignan-Figueras cross-border link all experienced financial distress, renegotiation or public intervention. It is tempting to conclude that high-speed rail and PPPs simply do not fit together. That conclusion is too easy.

The more interesting lesson from three decades of experience is that the model has learned. Early PPPs were often designed around a very ambitious idea of risk transfer: if demand, financing, construction and operating risks could all be moved to a private concessionaire, public budgets would be protected and private incentives would deliver efficiency. Experience showed the flaw in that logic. Risk does not disappear when it is transferred. A private partner will either price it, if it can bear it, or eventually return it to the public sector through renegotiation, insolvency or government rescue if it cannot. The relevant question is therefore not how much risk can be transferred, but which party can actually manage each risk at the lowest cost (Irwin, 2007; UIC, 2026).

High-speed rail is particularly unforgiving of mistakes in this respect. Projects require very large upfront investment, generate revenues only after long planning and construction periods, and operate over decades in which demand, regulation, technology and macroeconomic conditions will change. This contribution argues that a viable PPP model has nevertheless emerged. Its defining characteristics are mature public planning, private responsibility for construction and lifecycle performance, public retention of systemic risks, and deliberate de-risking to reduce the cost of capital. This does not make PPPs cheap. Nor does it remove the need for substantial public funding. But it can make them a credible delivery instrument where their higher long-term financial cost is justified by better delivery, lifecycle discipline or the ability to mobilise investment earlier.

The first generation: learning the hard way

The Channel Tunnel set the tone for the first generation of PPPs. The 1986 concession was structured as a traffic-based PPP with no direct public funding for construction. Private sponsors carried construction, financing and traffic risk. The infrastructure was a technical achievement and opened in 1994, but construction costs, leverage and weaker-than-forecast traffic produced severe financial distress. The original 55-year concession was extended by ten years as part of the 1997 restructuring. The lesson was not that the tunnel should not have been built; it was that a technically successful asset could still have an unsustainable financial structure when a highly leveraged private company was made responsible for risks that it could not fully control (UIC, 2026).

HS1 reproduced part of this problem. The Channel Tunnel Rail Link was initially awarded in 1996 as a traffic-based PPP. Yet the politically driven decision to route the line through East London to St Pancras created planning and cost consequences that could not sensibly be managed by the concessionaire. Lower traffic expectations then compounded the problem. The contract was restructured in 1998 and again in 2002, with the British government assuming most of the financial risk during construction; after further difficulties the concession entered public ownership in 2009 and was subsequently re-privatised. Again, the decisive problem was not construction capability. It was the attempt to make a long-term private contract absorb unresolved planning choices and uncertain demand (Preston, 2023; UIC, 2026).

Other projects reinforced the lesson. Taiwan High Speed Rail was launched as a highly leveraged traffic-based concession, with a debt-to-equity ratio of roughly 98:2, just as the Asian financial crisis transformed financing conditions. Borrowing rates rose by about 1.5-2 percentage points and the project had to be restructured; the state ultimately intervened and the concession was extended. Perpignan-Figueras offers an even cleaner example of misallocated risk. TP Ferro delivered the 44 km cross-border infrastructure broadly on time, but the Barcelona-Figueras connecting line was not completed until 2013, while certification and signalling interoperability also delayed traffic. The infrastructure was available; the traffic was not. The concessionaire had been given traffic risk without control over the public and regulatory decisions on which that traffic depended, and filed for insolvency in 2016 (UIC, 2026).

HSL Zuid in the Netherlands adds a related lesson about interfaces. The infrastructure itself was delivered through an availability-based PPP, while operations were placed in

a separate concession. ERTMS, rolling-stock certification and cross-border interfaces delayed effective operation and undermined the revenue assumptions of the operating concession. Formal contractual allocation could not make system-wide integration risk disappear. These cases explain why the early proposition, transfer as much risk as possible, has gradually been replaced by a more discriminating principle: transfer controllable risk.

The central lesson: allocate risk, do not merely transfer it

The international evidence points to a relatively stable allocation. Planning risk should largely remain public. Corridor selection, environmental assessment, permitting, land acquisition and major network interfaces depend on sovereign powers, political choices and democratic legitimacy. A private consortium cannot efficiently control a judicial challenge to a permit, a change in the preferred urban alignment or a delay in a connecting publicly delivered section. If these uncertainties are still open at financial close, bidders will price them conservatively or the contract will be renegotiated later. Mature planning is therefore not simply a preliminary administrative stage; it is the first and most effective form of financial de-risking.

Construction risk is different. Once alignment, land, permits and interfaces are sufficiently settled, the private partner controls engineering design, construction methods, procurement, sequencing and subcontractors. This is precisely where risk transfer can create incentives. Experience across high-speed rail PPPs is generally stronger on construction delivery than on traffic forecasting. Tours-Bordeaux, Perpignan-Figueras and the Spanish Albacete-Alicante systems PPP were delivered on or close to their construction schedules; even where projects later suffered financially, construction was often not the cause (UIC, 2026). The same logic applies to lifecycle maintenance and availability: the entity that designs and maintains the asset can be made responsible for meeting measurable performance standards over time.

Traffic risk is the clearest example of what should normally not be transferred. High-speed rail demand depends on GDP, competing air and road services, population patterns, fares, service frequency and quality, network effects and public policy. In vertically separated European railways, the infrastructure PPP controls almost none of these variables. Historical forecasting errors are correspondingly large. The UIC study records traffic outcomes substantially below forecast for the Channel Tunnel, HS1, HSL Zuid, Taiwan and Perpignan-Figueras; this is consistent with the wider evidence on optimism bias in rail demand forecasting (Flyvbjerg, Holm & Buhl, 2004; UIC, 2026). Giving this risk to an infrastructure concessionaire does not create a useful incentive. It simply increases the risk premium.

Macroeconomic and core political risks belong in the same category. Inflation, systemic interest-rate shocks, deep recessions, regulatory changes and changes in public investment policy are not diversifiable project risks. Portugal's suspension of its earlier high-speed rail PPP programme during the 2010-2012 sovereign debt crisis illustrates the point from the public side; Taiwan illustrates it from the financing side. Contracts can hedge limited financial exposures and define compensation or force-majeure mechanisms, but they cannot credibly privatise the economic cycle.

The more successful French experience shows what follows from this distinction. Bretagne-Pays de la Loire, opened in 2017, used an availability-based structure under which Eiffage Rail Express assumed design, construction, lifecycle maintenance and availability risk, while traffic, planning, public-policy and macroeconomic risks remained public. Careful preparation included land acquisition and robust cost and traffic studies. The project was delivered below its estimated cost and met performance requirements (Paix & Zabée, 2023; UIC, 2026). The Nîmes-Montpellier bypass followed the same broad availability logic. Tours-Bordeaux (LISEA) demonstrates that even a traffic-based concession can be made bankable, but only with substantial mitigation: detailed planning, a mature existing network, guarantees and public support. Public subsidies represented about 48% of project cost. It is therefore better understood as a carefully de-risked hybrid than as evidence that unmitigated traffic risk can be privately absorbed (Zabée & Paix, 2024; UIC, 2026).

De-risking is the route to lower cost

This evolution matters because risk allocation is ultimately a financing question. Private finance is structurally more expensive than sovereign finance. The UIC report estimates a financing premium of around 200-375 basis points for availability-based PPPs compared with public funding, with an even larger premium where traffic risk is transferred. For the new Czech projects, market consultation suggested debt margins of 170-250 basis points, equity returns around 11-12% and an indicative WACC spread of roughly 250 basis points. Compounded over a 25-, 30- or 50-year contract on a multi-billion-euro railway, this difference is substan-

tial (PwC, White & Case & Mott MacDonald, 2024; UIC, 2026).

The policy objective should therefore be to minimise the amount of expensive risk capital needed and the premium attached to it. The cheapest risk is the risk removed before procurement, not the risk transferred after it has become expensive. De-risking begins with completing planning and land acquisition, stabilising the regulatory framework and defining interfaces before financial close. It continues by choosing availability payments where demand cannot be controlled by the private party, scaling projects so that several credible consortia can bid, and using institutional finance to lower debt costs and provide a credibility signal. The European Investment Bank plays precisely this catalytic role in the new Portuguese programme.

This is not an argument for eliminating private risk. A PPP with no meaningful private exposure would merely be expensive public borrowing. Construction cost, delay, asset performance and lifecycle maintenance should remain firmly at risk where the consortium controls them. Nor should de-risking become blanket guarantees that socialise all downside while leaving upside private. The objective is narrower: remove or retain risks that the private party cannot manage so that competition is focused on the risks for which private incentives can create value. Refinancing gains after construction risk falls should also be shared, ensuring that public support for bankability does not become an unearned windfall.

There is an important warning here. Accounting treatment should follow sound risk allocation, not drive it. Using a PPP primarily to move investment off the public balance sheet can create incentives to allocate risks formally to the private sector even when they will return to government in a crisis. The result is often a higher financing cost plus a contingent public liability - the worst of both models. Value for Money, rather than accounting appearance, must remain the test.

Portugal and Czechia: the new generation

The current Portuguese and Czech programmes show how far practice has moved from the first generation. Portugal has divided the Lisbon-Porto line into several PPP sections, reducing individual deal size and widening the potential financing and bidding market. The Porto-Oiã concession, signed in July 2025 for 30 years, combines design, construction and maintenance with strong public and multilateral support; the EIB signed a first EUR 875 million tranche of a EUR 3 billion package for the line (EIB, 2025). By May 2026, Infraestruturas de Portugal reported that the Oiã-Soure PPP had been relaunched and that the Soure-Carregado PPP was planned for tender later in 2026. Portugal has also deliberately left signalling, communications and electrification outside parts of the PPP scope, allowing the infrastructure manager to control critical system integration while giving the concessionaire substantial design freedom within a defined corridor (UIC, 2026).

Czechia is following a similar learning curve. Its feasibility work identified three Moravian sections suitable for PPP delivery, with a combined length of about 205 km, and moved toward availability-based structures rather than traffic concessions (PwC, White & Case & Mott MacDonald, 2024). Segmentation, mature preparation, availability payments and the involvement of international financial institutions are not incidental details. They are the institutional expression of lessons learned from previous experiences.

Conclusions

Three decades of high-speed rail PPPs produce a more optimistic conclusion than the early failures suggest, but also a more modest one than the original PPP promise. The model is viable when it stops pretending that every risk can be privatised. Planning, political, macroeconomic and most traffic risks should remain with the public sector; design, construction, maintenance and availability can be transferred where private partners genuinely control outcomes. Mature planning and availability-based remuneration have consequently become the centre of gravity of the new generation.

The price remains important. Long-term private finance carries a persistent premium over sovereign borrowing, and the longer the concession, the larger the cumulative burden. The strongest policy response is therefore de-risking: remove avoidable uncertainty before tender, retain systemic risks publicly, use institutional finance and targeted guarantees to reduce the WACC, and preserve real private exposure only where it drives performance.

Finally, a PPP is a financing and delivery structure, not a new source of money. High-speed rail has rarely been able to fund its full infrastructure cost from users, and even successful PPPs depend on substantial public contributions, guarantees or long-term availability payments. The mature question is no longer whether private capital can replace the state. It cannot. It is whether public and private capital can

be combined so that each bears the risks it is best equipped to manage. The history of high-speed rail PPPs suggests that, after a costly learning process, the answer can increasingly be yes

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Financing Freight Railway Infrastructure: An Underappreciated Third Option?

Russell Pittman[1]

As governments around the world seek to convert freight shipments from road to rail, a frequently encountered hindrance is the poor state of rail infrastructure, with both bottlenecks and deferred maintenance causing delays and reducing the quality of service, resulting in shippers maintaining their reliance on road transport. The underlying mechanisms responsible for the poor state of rail infrastructure vary from country to country, but in a large number of cases they may be traced back to unreliability of government financing of the infrastructure matched by a demonstrated inability of these systems to successfully tap into sources of private capital. This in turn is related to each country's choice of rail reform strategy.

Reform models

For the past several decades, governments in countries with a heritage of a monopoly state-owned railway – generally in poor condition, overstaffed and offering poor service – have, often with the encouragement of the World Bank, the European Commission and/or the OECD – sought to reform the rail sector, usually with the hope both of attracting private investment into the sector and of increasing rail efficiency and traffic share via the introduction of some form of intramodal competition. Governments have generally chosen one of two contrasting reform models.[2]

In what we may term the European model, the strategy has been to create competition among freight train-operating companies (TOCs) 'above the rail' while maintaining a separate infrastructure monopoly, which is generally state-owned. Infrastructure access charges are regulated, and the activities of both the infrastructure operator and the TOCs may be subject to the jurisdiction of a rail regulator and/or a competition authority.

The alternative model – which we may term the Americas model – relies on competition among privately-owned vertically-integrated freight train companies that are generally not required to allow independent TOCs on their proprietary infrastructure. These vertically integrated railways may compete with each other on 'parallel' routes. For example, in the US containers arriving in Los Angeles/Long Beach may be carried by train to Chicago on either the Burlington Northern Santa Fe (BNSF) railway or the Union Pacific (UP) railway. They may also compete with each other to carry freight from a common origin or to a common destination. For example, agricultural products and auto parts destined for customers in Mexico City may arrive from completely different origins via Ferromex/Ferrosur or Canadian Pacific Kansas City.[3]

Strengths and weaknesses of the models

Different models may be chosen by reformers in different countries based on a variety of factors, including the size of the country, the mix of freight and passengers on the country's railways, the density of train operations and the capacities of the country's rail regulator and/or competition authority. Broadly speaking, however, we may say that each of these models has one great relative strength and one great relative weakness compared to the other.[4]

The primary strength of the European model is in fact its *raison d'être*: no shipper is in principle 'captive' to a single rail service provider. Under access conditions enforced by the regulator, independent TOCs operate on the monopoly infrastructure, and a shipper dissatisfied with its rail service provider may solicit another or begin train operations itself – or threaten to.

The primary weakness of the European model has been the continued ownership of the infrastructure by the state and the inability of the state to commit to providing sufficient funds for its maintenance and improvement, or to attract significant levels of private investment.[5] In principle, the infrastructure access charges paid by TOCs should be a

1Director of Economic Research, Antitrust Division, U.S. Department of Justice, and Visiting Professor, Korea University School of Law and Kyiv School of Economics. The views expressed are not purported to reflect those of the U.S. Department of Justice. The author thanks, without implicating, Edpo Covalciuk Silva, Lou Thompson and Frank Wilner for very helpful comments (and corrections!) on an earlier draft.

2 Pittman (2007).

3 Perkins (2016).

4 Pittman (2020a). See also Pittman (2017).

5 See, for example, European Commission (2001); Gómez-Ibáñez (2016); and European Rail Freight Association (2022).

significant source of investment funding, but this raises its own set of well-studied difficulties:

The variable costs imposed on a system by the operations of a particular TOC – which vary by commodity, speed, wheel condition and other factors – are notoriously difficult to measure;[6]

Access charges with minimal mark-ups over the variable costs imposed by the TOCs encourage track use and support an increasing share of rail transport but contribute little to the fixed costs of the network;

Access charges with high mark-ups over variable costs contribute to the fixed costs of the network but prevent efficient use of tracks by TOCs, the willingness of which to pay exceeds their marginal costs imposed; and

The economist's second-best solution, a form of Pigouvian access price discrimination such as two-part tariffs or Ramsey pricing, runs the risk of prohibition by the regulator or competition authority for being (by definition) discriminatory.[7]

In contrast, the primary strength of the Americas model of restructuring has been its ability to attract private investment in the infrastructure. According to the Association of American Railroads and the Railway Association of Canada, each of the six North American Class I freight railways invests billions of dollars each year in capital expenditure and maintenance.

The primary weakness of the Americas model is that in a nationwide system of vertically integrated freight railways, many shippers are located on only one railway, and if they are unable economically to use other transport modes or to transload their cargoes to other railways, they are 'captive' to their single serving railway. Regulators and competition authorities in Canada, Mexico and the US have struggled to arrive at effective ways to protect such shippers from monopoly abuses, with various degrees of focus in each country on price regulation, compulsory track access or both.[8]

Are there any other structural reform options?

Other options?

An alternative strategy might follow the "competitive rules joint venture" (CRJV) model introduced by the US Department of Justice in 1976 in the context of deepwater oil terminals and analysed in a subsequent paper by Warren-Boulton, et al. (1992).[9] The details of different versions of the model vary, but the broader model calls for downstream users of monopoly infrastructure to form an independent joint venture that owns (or has a concession for) and operates the infrastructure under agreed-upon rules to both ensure the financial health of the infrastructure and to prevent anticompetitive behaviour by the users. User owners of the joint venture pay equal amounts to the CRJV to endow the original joint venture formation in return for equal shares in its governance, and then agree to contribute equal further amounts requested by the joint venture for further maintenance and investments. In our case, TOCs would pay identical access fees for each train or car using the infrastructure.

Details to be decided upon to form such a CRJV include the following:

The level of access charges. Access charges set to marginal infrastructure costs yield the most efficient level of TOC use but require more TOC fixed contributions to infrastructure costs.

Fixed or dynamic TOC ownership shares in the CRJV. Lewis and Reynolds (1979) and Boffa and Panzar (1998) argue for dynamic ownership shares based on TOC infrastructure use in order to encourage output expansion along a declining cost curve, although Lewis and Reynolds suggest that this may be unnecessary if access prices are set at a marginal cost.

Use of the infrastructure by non-owner TOCs. Lewis and Reynolds (1979) and Warren-Boulton, et al. (1992) suggest that openness to other TOCs may help to prevent anticompetitive output restriction by the TOC owners.

The basic framework of the CRJV is familiar from the long successful history of 'belt railways' and 'port railways' in the US, and Mexico City's Ferrovalle, the belt railway owned in equal shares by Ferromex, CPKC and the Mexican government. These short-line railways offer the larger

6 Wilson and Bitzan (2003).

7 See, for example, Bureau of Transport and Regional Economics (2003); Pittman (2004); Nash (2005); and Thompson (2008). Valuable broader discussions of the economics of access pricing include Armstrong, et al. (1996); Laffont and Tirole (2001); and Decker (2023).

8 Pittman (2025). See also Transportation Research Board (2015) and Pittman (2020b).

9 U.S. Department of Justice (1976) and Warren-Boulton, et al. (1992). See also Lewis and Reynolds (1979); Ferriera (1997); Park and Ahn (1999); and Boffa and Panzar (1998).

freight railways last-mile services and access to competing long-haul carriers, and facilitate interline transfers.

With its combination of private capital for the infrastructure and choice of carriers by shippers, the rail CRJV arguably combines the best features of the European and Americas rail restructuring models.

Consider two examples.

The Norfolk & Portsmouth Belt Line Railroad (NPBL) serves the ports of Norfolk and Portsmouth on the Virginia coast of the Atlantic Ocean. The NPBL was formed by an agreement among eight line-haul freight railways in the eastern US. The original agreement of 7 July 1897 included the following provisions:

The eight signees agreed to pay equal up-front costs and to contribute additional funds as called for in the future by the board of directors;

The eight signees would each have one seat on the eight-member board, with equal votes in board deliberations;

The line would be "constructed, maintained and operated under a separate organisation in which all are to be equally interested and each to have an equal representation";

The company would issue bonds to pay for construction and maintenance;

The members would pay a uniform per-car rate for use of the infrastructure; and

The use charge would be set (and reset as necessary) at a level sufficient to pay interest on the bonds and a six percent dividend on the stock.

There is no mention in the agreement of the use of the NPBL by non-member railroads.[10]

A century of rail mergers has reduced the current ownership to two members: Norfolk Southern (NS) and CSX.

A second example is the Belt Railway Company (BRC) of Chicago, which was founded in 1882 as a subsidiary of the Chicago & Western Indiana Railroad, which signed lease agreements with five railroads to use the infrastructure. In 1962 the user railroads – a group of twelve by then – bought the Belt Railways, and each had a seat and an equal vote on the board of directors. A proposal for major capital improvements required agreement by seven of the twelve. The BRC is now owned by the six North American Class I railroads: BNSF, CN, CPKC, CSX, NS and UP.[11]

Railroads wishing to use the BRC that are not co-owners may pay a uniform tariff rate and do so while the owners pay a share of the BRC's net costs at the end of each month, their share being weighted by the number of their cars on the system that month. Their per-car tariff is always less than the tariff paid by non-owning railroads.[12]

Broadly similar and comparably long-lived belt railways that continue to operate in other US cities include the Terminal Railroad Association of St. Louis, founded in 1889, and the Houston Belt and Terminal Railway, established in 1905.

In addition, at least two major ports have similar all-access port railways that are government owned: the New Orleans Public Belt Railroad, established in 1900, and the Port of Montreal Railway, nationalised by the Montreal Port Authority in 1907.

Discussion

Belt and port railways like these may in some cases operate hundreds of miles of track, although there is no experience with the type of rail CRJV discussed here in the context of the larger line-haul railways that may be currently considering reform models. Therefore, adoption of this alternative model of rail system restructuring for an entire national rail system might be considered risky. However, as with other policy innovations, there is no reason that a country should not start small and then expand and adjust over time.

The advantages of the rail CRJV model are basically twofold, and arguably they combine the best features of the two mainstream models in use today. As in the Europe-

10 The Agreement is available on the STB website as an Appendix to the 27 February 2025 filing of CSX in STB Docket No. 36836, Norfolk Southern Corporation and Norfolk Southern Railway Company – Acquisition of Control – Norfolk & Portsmouth Belt Line Railroad Company. See Railroad Age Gazette (1908); State Corporation Commission of Virginia (1916); "Norfolk and Portsmouth Belt Line," https://www.virginiaplaces.org/rail/norfolkportsmouth.html; Moomaw (1998); and Burns (2024b).

11 Burns (2024a). See also Drury (2007) and the railway's website, https://beltrailway.com/about-2.

12 Jerry A. Pinkepank (1966), September, 36-46 and October, 42-49.

an model, shippers along the infrastructure of the CRJV have their choice of TOCs, at least among the joint owners of the CRJV and in some cases with non-owner TOCs as well. In addition, the railroads operating on the infrastructure pay access fees that contribute to the capital budget of the infrastructure. As in the Americas model, the infrastructure is primarily paid for with private capital, in addition to access fees. In other words, intramodal competition along with a reliable stream of private capital for the infrastructure: arguably a win/win proposition.

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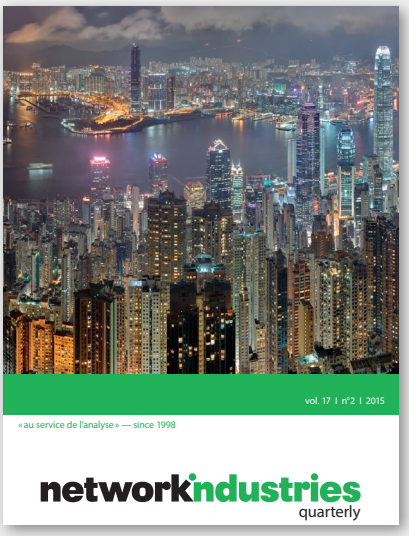
Elodie Petrozziello Managing Editor:
elodie.Petrozziello@eui.eu
Ozan Barış Süt, Designer:
ozanbarissut@gmail.com



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