

Brunekreeft, Gert

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Gert Brunekreeft

**Network Unbundling and Flawed  
Coordination – Lessons from Electricity  
and Railways**

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**Editors:**

Prof. Dr. Gert Brunekreeft

Dr. Roland Meyer

Jacobs University Bremen

Bremen Energy Research (BER)

Campus Ring 1 / South Hall

28759 Bremen

[www.jacobs-university.de/](http://www.jacobs-university.de/)

<http://b-e-r.user.jacobs-university.de/>

**Contact:**

Dr. Roland Meyer

Tel. +49 (0) 421 - 200-4868

E-mail [ro.meyer@jacobs-university.de](mailto:ro.meyer@jacobs-university.de)

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# Network Unbundling and Flawed Coordination - Lessons from Electricity and Railways

**Gert Brunekreeft<sup>1</sup>**

Jacobs University Bremen  
College Ring 2  
D-28759 Bremen  
Germany

Email: g.brunekreeft@jacobs-university.de

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*Abstract:* What is a good balance between competition and coordination in network industries? Network unbundling aims to promote competition, but this has to be balanced against the downside of unbundling: firm-internal coordination falls away and must be replaced by external market mechanisms. This is a non-trivial task. The cost of flawed coordination as a result of fragmentation can be substantial and policy should focus more on the cost of coordination and on governance structures to secure coordination. This paper examines three persistent sources of flawed coordination: 1) a regulation versus unbundling dilemma, 2) difficulties with optimal network charging and 3) strategic behavior resulting in misaligned incentives. Practical relevance is underlined with lessons from (European) electricity and railways.

*Keywords:* electricity, railways, unbundling, regulation, competition policy

*JEL-classification:* L43, L51, L92, L94

## 1 Introduction

Is network unbundling a blessing or a curse? Network unbundling primarily aims to improve competition in network industries. It is hard to disagree with this aim. On the downside, it gets increasingly clear that further fragmentation of highly interrelated, technically complex systems causes significant cost: the cost of flawed coordination. A prominent example is the analysis of the British Rail system in the McNulty report (2011). The systematic lack of whole-system optimization causes overall-system inefficiency. We have to question whether further unbundling pays off and whether the benefits of more competition outweigh the

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additional cost of flawed coordination. This contribution explores the costs of coordination analytically and looks at experience from electricity and railways sectors.

The European electricity sector is now in the phase of the 3<sup>rd</sup> Directive 2009.<sup>2</sup> In the sector inquiry of 2007<sup>3</sup> the European Commission argued that the development of competition in European energy markets was too slow. As a result, the Commission proposed further network unbundling, especially aiming at mandatory ownership unbundling. Although this was not politically feasible, the resulting political compromise with very restrictive legal unbundling is far-reaching in practice. Analysis of the Impact Assessment (IA-Energy 2007) quickly reveals that the Commission argues strongly towards the benefits of more competition, but largely ignores the downside of unbundling: the cost of coordination. The same is now happening in railways. The Commission launched a draft for the 4<sup>th</sup> Railway Package in January 2013 in which it expresses its preference for ownership unbundling of the rail infrastructure. Outlined in the Impact Assessment (IA-Rail, 2013), the Commission sets strongly on the goal of competition, but tends to neglect the costs of unbundling. The so-called McNulty report (2011) for the UK government studies the efficiency of the UK-railway system with two main conclusions: 1) the UK railway system is significantly less efficient than comparable peers, 2) the main cause of the inefficiency is far-reaching fragmentation of the system leading to misaligned incentives. In IA-Rail (2013), the European Commission does quote the McNulty report, but fails to acknowledge the implications. These implications are that 1) there is a limit to unbundling, where the costs start to outweigh the benefits, and 2) the policy focus should be on the design market mechanisms to secure coordination.

This paper explores in-depth three sources of coordination costs: 1) regulation versus unbundling dilemma, 2) difficulties with optimal network charging and 3) strategic behavior resulting in misaligned incentives. These are persistent sources and difficult to resolve.

Section 2 discusses the debate around unbundling in the electricity sector. Section 3 analyses the three sources of costs of coordination. Section 4 picks up the debate in railways and compares to electricity. Section 5 gives concluding remarks.

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<sup>2</sup> EU-Commission, 2009, „DIRECTIVE 2009/72/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC”, 14.08.2009, Brussels.

<sup>3</sup> EU-Commission, 2007, DG Competition report on energy sector inquiry (SEC(2006)1724, 10 January 2007).

## 2 Unbundling in the Electricity Sector: The 3rd Electricity Directive

The electricity sector is a classic example for an infrastructure-based network industry: in the value chain the high-voltage transmission networks and the low-voltage distribution networks are natural monopolies with sunk costs. There is no scope for network competition and therefore monopoly regulation is necessary, as is today widely accepted. The regulation typically consists of access regulation (securing a level playing field) on the one hand and profit regulation (usually with a variation of RPI-X regulation) on the other hand (cf. Brunekreeft, 2003). In contrast, generation (production of electric power), trade and retail (the sale of electric power to end-users) are commercial stages. The promotion of competition in commercial stages is a primary aim of European energy policy and the liberalization of electricity markets. Entry in generation and retail is free. European end-users are free to choose their electricity supplier (i.e. retail competition).

Since the first steps towards market liberalization 1996, there has been debate over the “right” degree of vertical network unbundling to secure a level playing field.<sup>4</sup> Figure 1 below gives an overview of the three steps of European policy.

<b>EU: First directive 1996/92/EC</b>	<b>EU: Second directive 2003/54/EC:</b>	<b>EU: Third Directive 2009/72/EG</b>
<b>► Unbundling: <i>accounting separation</i></b>	<b>► Legal, functional and managerial unbundling</b>	<b>► Option out of three:</b>
<ul style="list-style-type: none"><li>• Non discriminatory network access</li><li>• Prevention of cross-subsidies</li><li>• Transparency</li></ul>	<ul style="list-style-type: none"><li>• Legal unbundling</li><li>• Managerial unbundling</li><li>• Personnel split</li><li>• Independent decision rights for network maintenance.</li><li>• Firewalls</li></ul>	<ol style="list-style-type: none"><li>1. Ownership unbundling</li><li>2. Deep-ISO</li><li>3. Independent Transmission Operator (ITO) (“third way”)</li></ol>

*Figure 1: EU-policy of network unbundling in the electricity sector*

The first step was made with accounting separation in the 1996-directive, which is a light form of unbundling. The second and rather more severe form of unbundling was legal unbundling in the 2003-directive. Basically, these requirements almost fully separate the network from the commercial businesses stopping just short of ownership unbundling. The debate on network unbundling intensified with the “sector inquiry” of 2007 by the European Commission, focusing especially on transmission networks. Notwithstanding already existing unbundling requirements, the sector inquiry concluded that progress in competition in European energy markets was insufficient and made proposals for improvement, inter alia

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<sup>4</sup> See for an overview Brunekreeft (2003).

network unbundling. The proposal reflected the European Commission's concerns about the potential for vertical foreclosure impeding effective competition. After controversial debate, the European Parliament decided on the 3rd Energy Package<sup>5</sup> in 2009. The provisions on unbundling express a political compromise; the primary aim of the European Commission, full ownership unbundling, was not politically feasible and the Commission had to settle for a compromise giving Member States the option to choose. The option also reflects the controversy about an "optimal" vertical structure and the notion that there may not be a "one size fits all" approach.

The electricity directive 2009 now allows each Member State to choose between:

- Full ownership unbundling
- deep Independent System Operator (ISO)<sup>6</sup>
- Independent Transmission Operator (ITO),

Full ownership unbundling implies a strict (ownership) separation of generation and transmission assets. The ITO model, by contrast, implies a stronger form of legal unbundling,<sup>7</sup> but does not require network divestiture; therefore ownership structures are left intact.

Whilst preparing the 3rd Energy Package, the European Commission published an Impact Assessment (IA-Energy, 2007) to support the main reform proposals. The Impact Assessment illustrates the reasoning of the European Commission and provides a clear indication that the European Commission favored full network ownership unbundling. The IA-Energy (2007, pp. 33 and 74) describes seven expected effects of unbundling, among which the most prominent are: the effect on competition and the effect on network investment. It is striking that the commission emphasizes the benefits of unbundling, but does not list the costs of unbundling (cf. IA-Energy, 2007, section 5.1 pp. 33-45). We deal with the cost of flawed coordination in section 3; here we will first discuss the approach of the European Commission in the Impact Assessment.

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<sup>5</sup> Strictly speaking, this would be electricity and gas, but since the focus of this paper is on electricity markets we will further ignore gas, unless explicitly mentioned otherwise.

<sup>6</sup> This is option is rather special and it is beyond the scope here to go into detail. It aims to separate system operation (SO) from the transmission ownership (TO); the TO (ownership of transmission assets) can remain integrated with generation assets. We find several examples of ISOs in the US, but they hardly used in Europe, and because the application to railways seems limited, we further ignore the ISO-model. The interested reader may be referred to eg. Brunekreeft & Balmert (2010) for more detail.

<sup>7</sup> In particular, the following points: the ITO needs to be fully functional standing alone, the supervisory board of the ITO is a step more distant from the parent company, and the independence of the ITO on investment decisions is larger than before.

The objective to improve competition can only be welcomed. However, the analysis does not stop here. Before opting for the sharpest instrument (ownership unbundling), we would have to answer two questions: 1) how much additional competition compared to the status quo of legal unbundling and access regulation would be achieved by further unbundling and 2) how large is the benefit of the additional competition as compared to the cost of additional unbundling steps? Both questions remained unanswered in the Impact Assessment. The fact that electricity prices in north-west Europe decreased and are currently very low may illustrate this point. The current competitive pressure comes to a great extent from excess generation capacity caused by the large-scale integration of renewable energies, especially in Germany. The relation between unbundling and competition is ambiguous; other market factors, such as excess capacity, may have far more impact on competitive conditions.

The IA-Energy (2007) also mentions the reduction of cross-subsidies as one of the positive effects of unbundling. The cross-subsidies argument is that an integrated firm has an incentive to shift costs from the competitive business to the regulated network. In doing so, the firm can inflate the regulatory cost base of the network and thereby try to raise the level of allowed network charges; thereby the margin of the competitive business is decreased and effective competition foreclosed. According to the Commission, only vertical ownership unbundling would remove this incentive and thereby improve the level playing field on the competitive market. However, the first and second directives already established restrictive rules to avoid cross-subsidies. Practical experience suggests that under the rules of legal unbundling, cross-subsidizing is actually difficult to do. The case of distribution network operators in the Netherlands illustrates this well. After repeated informal complaints, the competition agency in the Netherlands started an inquiry into cross-subsidies in the Dutch electricity sector (NMa, 2007). At the time of the inquiry, the distribution network operators were subject to legal unbundling following the rules of the EU directives of 2003. Following in-depth inquiries at the four distribution network operators, the NMa concluded that there was no convincing case of cross-subsidies. Consequently, we have to be careful considering the reduction of cross-subsidies as an argument for full ownership unbundling. Although intuitive in theory, practice does not give unambiguous evidence to support this conclusion.

Empirical literature on the effects of unbundling is thin, but all in all give cause to reduce high expectation of the net benefits of ownership unbundling. Without claiming to provide a



comprehensive survey, the following studies are worth mentioning. Growitsch & Stronzik (2011) make an empirical analysis of the effect of unbundling in gas markets and conclude that ownership unbundling does not have a price-reducing effect. Meyer (2012a) provides a comprehensive survey of the empirical studies of the effects of unbundling on the cost-efficiency of the electricity sector and concludes that ownership unbundling could lead to a significant cost increase of up to 5% for the overall sector. This seems to be confirmed by an econometrical study in Meyer (2012b). De Nooij and Baarsma (2009) investigate ownership unbundling of electricity distribution networks in the Netherlands and conclude very significant costs. Lastly, PWC (2013) makes a status-quo analysis and outlook of ownership unbundling of electricity distribution networks in the Netherlands and concludes that ownership unbundling so far did not deliver the promises. The IA-Energy argues that ownership unbundling improves investment incentives. Theory and empirical evidence are almost completely silent on the issue. As an exception, Gugler, Rammerstorfer and Schmitt (2013) provide a panel data study of policy reforms, which relates unbundling to investment in the European electricity sector. They conclude unambiguously that ownership unbundling leads to less investment.

The unbundling rules are already adjusting to practical problems. Investment in transmission lines has become a problem. Unbundled transmission networks rely on the market for external equity; most are too small to acquire sufficient internal equity. In contrast, integrated transmission networks get equity from the mother company. Access to external equity is problematic (cf. Roland Berger, 2011). This is in part caused by the restrictions on the possible investors. External investors would typically be life insurances and pension funds. Such investors seek long-term, low-risk investments, which is what electricity network investments offer. Usually these are large, globally active funds investing in a diversity of assets. As mentioned by Findeisen and Koch (2013), for unbundling provisions, legally, such investors are not allowed to participate in for instance an offshore transmission line if they are already owner of a power plant in a country where ownership unbundling applies. Unfortunately, this excludes a large part of potential investors for transmission projects. As discussed by Findeisen and Koch (2013) regulators are taking a pragmatic approach and grant exemptions on a case-by-case basis if financial participation is not expected to impede competition.

The European Commission highlighted the asserted benefits of ownership unbundling, but ignored the detrimental effects of unbundling on coordination. Section 3 will discuss the downside of ownership unbundling: it will explore three persistent sources of cost of flawed coordination.

### **3 The cost of unbundling: the lack of coordination due to misaligned incentives**

The cost of unbundling may be substantial and they need to be balanced against the benefits. Usually, we distinguish two classes of costs. Firstly, direct synergy losses. In an unbundled world, some services and facilities need to be doubled, leading to higher costs. This group of costs is not the focus of this paper and it suffices to point out, as mentioned above, that they can be significant. Secondly, being the focus of this paper, the cost associated with flawed coordination. These are system costs: the costs of flawed coordination between different decentralized agents in a fragmented system need not be felt by the individual agents, but are incurred by the system overall. Following the McNulty report (2011), we call this “misalignment of incentives”. We will discuss a selection of critical points and illustrate with examples from electricity systems and railways.

The steps in an electricity value chain are strongly interrelated and the actions need to be coordinated to secure optimal operation and investment. In the old world with closed monopolies and vertically integrated utilities, coordination was *internal* within one and the same firm. The incentives of different actors within the company were aligned at shareholder level. Liberalization, competition, unbundling, and the emergence of new players result in fragmentation with a large set of decentralized actors with widely different incentives; these need to be coordinated *externally* by a market mechanism. To be sure, in many markets this is completely normal and we trust that Adam Smith’s “invisible hand” guides the decentralized actions. Looking somewhat more closely, the invisible hand is usually visible as a set of markets, prices and contractual arrangements. This is the key problem for the liberalized and fragmented network sectors: in electricity and also in railways this system of network charges and contracts to arrange market coordination is at best imperfect. Explicitly, the McNulty-report (2011, p.9) on the British railway system stresses that inadequate network charging systems are at the core of misaligned incentives.

Key to misaligned incentives are spillover effects: One party incurs costs, which create benefits for another party, but which cannot be fully recouped. Where spillovers are not internalized, we call these externalities. In our case, where we are dealing with the interaction between an unbundled network and commercial businesses, we call these vertical externalities. Two examples may illustrate. In railways, track maintenance affects train operations and reverse. Better track maintenance creates benefits for train operators, and better rolling stock causes less damage to tracks, thus creating benefits for infrastructure managers. In electricity, transmission network expansions relieve network congestion. This allows higher power plant utilization of plants behind the network constraint; thus the power plant benefits from the network expansion.

In an integrated company, the decisions of different departments are jointly optimized: whole-system optimization. In a setting with vertical separation, the decisions of the different parties are optimized individually. Exactly this causes misaligned incentives. The theoretical literature is full of models, which show that the outcomes of joint and separate optimization generally differ.<sup>8</sup> The following numerical examples depicted in table 1 illustrate the problem.

		(A) Payoffs of Network (IM)	(B) Payoffs of Commercial business (RU)	Sum of Payoffs of IM and RU
<b>Example 1</b>	• Separate optimization	60	40	100
	• Joint optimization	80	30	110
<b>Example 2</b>	• Low network maintenance	60	40	100
	• High network maintenance	50	60	110

Table 1: Examples of misaligned incentives

Assume a network operator “IM” and commercial activity “RU”.<sup>9</sup> Let the hypothetical numbers be net pay-offs.<sup>10</sup> Example 1 shows a case where joint optimization would increase

<sup>8</sup> The interested reader may be referred to the theory of vertical relations in the field of industrial organization (Perry, 1989, and Posner, 1976; for a textbook approach see Motta, 2004).

<sup>9</sup> These abbreviations are borrowed from railways literature and denote infrastructure manager (IM) and railway undertaking (RU).

joint profit, but such that IM gains while RU actually loses. This example describes the situation, which is known in the literature as “double marginalization”, where joint optimization is better for the companies, as well as for society.<sup>11</sup> However, if nothing else, RU will not want this, because RU would lose from cooperation. These are misaligned incentives; RU would block the jointly optimized solution and would only participate if it gets compensated; IM and RU will need to find a profit-sharing model. In example 2, IM invests in maintenance; IM incurs costs and lowers its profits to the benefit of RU, who gains. Overall profit increases. In example 2, IM would not have adequate incentives to invest in maintenance and would have to be incentivized by a side-payment from RU. Again, these are misaligned incentives. Importantly, misalignment of incentives only happens in vertical separation, where decisions are made individually; vertical integration re-aligns incentives because only the whole system matters.

If markets cannot resolve this lack of coordination, the classical answer in the literature is vertical integration.<sup>12</sup> But why would the market not be able to restore coordination? In this section, we discuss three persistent weaknesses of market coordination.

### **3.1 A “regulation vs unbundling” dilemma**

Further fragmentation requires revenue sharing to align incentives. But is this possible under the constraints of regulation? In electricity markets we find many examples of spill-overs; however, many constraints put upon network charging make cost- or revenue-sharing models difficult (Brandstätt, Brunekreeft & Friedrichsen, 2011a and 2011b). A “regulation versus unbundling” dilemma can lead to inefficient outcomes. Suppose there are positive spillover effects from the network to the commercial business. Two options follow:

- The network owner can leave it to a third party and internalize spill-overs with revenue sharing, unless regulation prohibits this, or,
- The network owner can undertake commercial activity itself and make the profit on the commercial side, unless unbundling prohibits this.

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<sup>10</sup> Whether the pay-offs are „profits“ or „social welfare“ is irrelevant. What matters is that the incentives are asymmetrical.

<sup>11</sup> This is well-established and can be traced back to Cournot. For instance Motta (2004, pp. 307 ff.) gives a good explanation of double marginalization.

<sup>12</sup> This line of reasoning has been explored in detail in transaction cost economics, following especially the seminal work of professor Oliver Williamson (eg. 1975).

A problem arises if both strict regulation and strict unbundling apply. Taken together this is a “regulation versus unbundling” dilemma and can easily lead to inefficient outcomes.

The following two numerical examples illustrate how the outcome can be inefficient. They are a bit specific for electricity networks, but are mentioned here because of their practical relevance. Table 2 summarizes the numerical examples.

	Type of cost or revenue	Cost/Rev.	Net profit network	Social welfare	
				Unbundled	Optimal
A	Network expansion	1,000	-800		-1,000
	Investment in smart metering system	800		-1,100	
	Cost of curtailment	300			
B	Network expansion	1,000	-1,000	-1,000	
	Investment in storage facility	1,100			-800
	Revenue of trade with stored power	300			

Table 2: Numerical examples of unbundling-versus-regulation dilemma.

In example A, we face the following trade-off. Solar power fluctuates, depending on sunshine. Assume that feed-in of the solar power at peak capacity requires a network expansion. Suppose that network expansion can be avoided (1000) if the solar plant is curtailed at close to peak capacity; say, it can run at 95%, but not at 100% because it would congest the network; 5% would have to be curtailed. The solar power plant incurs cost for not producing (300), as it foregoes revenue. Suppose that network owner and solar plant are different parties. In order to be able to curtail the plant, the network operator needs to install a smart metering system (800). Suppose further that network regulation sets incentives to find the least-cost option. It is straightforward to see that under these circumstances, the network operator will opt for curtailment (800 is less than 1000), although network expansion would be the optimal solution (1000 is less than 1100 (=800+300)). Why is this so? The network operator does not incur the spill-over cost of curtailment. Restoration of the optimal outcome requires a cost-sharing agreement or loosening unbundling rules to some extent.

Example B is slightly more complicated. Suppose we face network congestion, which can be relieved either by network expansion or by a storage facility. This option is discussed for wind power; wind power would be stored when there is too much, and brought back into the

system again when there is too little power. Incidentally, when there is a lot of wind, power prices tend to be low, and when there is little wind, power prices tend to be high; if the storage facility is in place, the owner can arbitrage between different periods and gain additional trading revenue (300). Assume that unbundling rules are such that the network owner is allowed to build the storage facility (1100) (as part of the network) but not to trade with power (commercial business). Again assume that network regulation sets incentives for the low-cost option. If nothing else, the network owner will expand the network (1000 is less than 1100), although storage would be the optimal outcome (800 (=1100 – 300) is less than 1000). Again, the problem is the spill-over: the storage investment creates a trading revenue which is not captured by the network owner. The optimal solution requires a revenue-sharing agreement or loosening unbundling rules to some extent.

These are mere examples<sup>13</sup> and in detail the picture is far more complicated and depends strongly on additional assumptions. However, this simple illustration brings a straightforward message. Under strict unbundling, regulation needs to be loosened (allowing revenue- or profit-sharing models); this includes in particular, loosening constraints on tariff structures. Under strict regulation, unbundling rules must be loosened (allowing holding structures, cooperation, joint ventures and the like).

### **3.2 *Optimal charging is difficult***

Even if there were no regulatory constraints on network charging, effective differentiated charging would still be a challenge. Network charging serves two purposes: 1) to finance the cost of the network and 2) to signal use of the network. As will be explained in more detail in section 4, the McNulty report (2011, p. 9) for the UK government stresses (among other things) two reasons for the inefficiency of the UK rail system:

- “Fares structures do not send efficient pricing signals
- The industry’s legal and contractual framework is complex”

This is precisely the point: it is hard to get it right.

This is also the experience in electricity networks. So-called “locational pricing” to deal with congestion in electricity network systems provides an excellent example. Operation of the

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<sup>13</sup> These examples are not statements that smart meters or storage would not be useful; they are mere examples of the spill-over effects.

network is managed with the power plants; to manage the network, the operator runs the power plants up or down depending on technical conditions and location. This creates an immediate link between network and power plant. Prices and contracts need to set signals for the power plants. In theory and practice there are different ways to do this. Which hurdles are encountered in practice when price differentiation is to be implemented (cf. Brandstätt et.al., 2011b and Brunekreeft, et.al., 2005):

- Distributional effects may be substantial. Inevitably, the result of differentiated charging is that some network users gain and others lose; this of course is typical for charging as a signaling device.
- Usually, charges of commodities like transports and energy are used for socio-political goals set by the government. For instance, support policy for the socially vulnerable and rural areas.
- Fairness or even the law dictates equal treatment of equal users. Of course this is a large grey area, but obviously restricts the scope for differentiated charging.
- Competition policy will set constraints on differentiated charging if this impedes competition among network users. This is a serious issue in railway network charging.
- The networks are heavily regulated. Regulators and/or legislators might have imposed severe and explicit restrictions on charging.
- A slightly more complicated issue is that differentiated charging may be in conflict with the revenue cap, if there is one. The revenue cap is a constraint on finance, differentiated charging is a price signal; these may be in conflict.
- Regulatory costs to implement and control an alternative system, especially if differentiated and possibly in conflict with the revenue cap, can be high.
- Informational problems; sometimes it is simply not straightforward how to set optimal differentiated charges. Sufficient information or incentive compatibility may not be given.
- Effectiveness may be low; network users express low response rates, reflected in low price elasticities.
- Lastly, and genuinely associated with unbundling. An end-user price is the sum of the service and network component. First, if the network charge is paid by the suppliers (for whom this is a cost component), it is not clear whether the signal of the network charge reaches the end-user or is absorbed by the intermediate stage (service or supply). Second, networks and suppliers will have different interests and the signals of the network and service component may conflict.

In theory, design and implementation of differentiated network charging is straightforward; in practice, it is not.

Network charging starts to develop from a financing tool to a signaling device. To make a fragmented world work, a differentiated set of charges is key for the optimal coordination. However, this is easier said than done. Even if we know optimal charging systems, implementation in practice runs into many problems, not the least, due to regulation, competition policy and politics.

### **3.3 *Parties act strategically***

Network sectors, like railways and electricity, deal with large sunk investments with long and diverse life durations. Ahead planning takes a long time. The life duration of electricity transmission network infrastructure is between 40 and 60 years; the life duration of power plants depends on technology and varies between 20 and 40 years. In railways, the life duration of infrastructure can expand up to 80 and 100 years. Moreover, the planning time for network expansion is considerably longer than for power plants or trains and locomotives. The network owner must plan and invest under (strategic) uncertainty. With regard to the UK rail system, the McNulty report (2011) draws attention to the difference in the long-term view of the infrastructure manager compared to the short-term views of the transportation operating companies and calls this (McNulty report, 2011, p. 36): “an unhelpful degree of short-termism”.

Short-termism has also become a problem in the planning of electricity network development. In its ‘Ten Year Network Development Plan’, the group of European Transmission System Operators, ENTSOE (2010, p.38) states: “As a matter of fact, the most important source of uncertainty came as the consequence of the more complex coordination between generation and transmission planning due to the unbundling of the industry enacted in 1999”. They further state that “a large number of these [connection] requests do not materialize into concrete projects and there is no requirement for developers regarding the transparency of their portfolio evolution. This portfolio often encompasses projects in very different locations”.



Strategic behavior worsens uncertainty. Power plant investment plans have become commercially strategic information, which is used as such; in particular, network users wait until the last moment before providing information (Brunekreeft and McDaniel, 2005) and change plans regularly. In a context of power plants connected to a congested electricity transmission network, Brunekreeft & Friedrichsen (2010) study the incentives to provide truthful information in a game-theoretical setting and show that incentives to lie do exist and can easily lead to inefficient outcomes.

The offshore wind projects in the Northsea in the north of Germany have become a problem. Most notably so are the problems for the Dutch-German TSO TenneT, which is the designated investor for most of the offshore transmission lines. TenneT has difficulty raising the funds for investment. Multiple problems exist. One of the main problems are high risks, which keep investors away. One risk concerns timing in construction of lines and windparks. Being late is costly for the line investor, as the line owner is liable for income outages in case wind cannot be delivered. This is a genuine problem of unbundling: the other side of the risky project is a different party with different commercial interests: the potential costs as a consequence of wrong timing are not taken into account by the other party, implying that timing is suboptimal. Moreover, as noted by Behr et.al. (2013, p. 25) the windpark and the network investor faced a chicken-egg problem: the windpark investor waited for the network to be planned, and the network waited for a commitment by the windpark investor. Since Jan. 2013, the order has been changed by law: the network plans first, and the windparks follow and the network investors now have to provide an advance “Offshore Network Development Plan”. This solves the chicken-egg coordination problem, but now it is not clear what happens with stranded investment, if windparks change their plans (cf. Behr, et al., 2013, p. 50). This is a genuine problem associated with unbundling: a vertically integrated setting would internalize these risks. The risk would not go away, but the incentives would be aligned.

It is hard to re-align different incentives. The literature is full of theoretical models and practical examples of strategic behavior. Theory has made impressive progress with “optimal incentive mechanism design” (following Laffont & Tirole, 1993), that curb the incentives within a contractual framework; so far, application in practice is complex and imperfect at best, implying that re-alignment of different incentives in a fragmented system remains to be a challenge. This section turned the attention to the downside of unbundling; it gets increasingly clear that further fragmentation causes cost of misaligned coordination. In the next section we

discuss how the European Commission deals with this experience and how it applies these insights to the railway sector.

## 4 The 4th Railway Package

### 4.1 *The status quo and on-going developments*

Like the energy sector, the European railway reform has always been accompanied by a heated debate on the “right” degree of unbundling since its initiation in the 1990s (cf. Knieps, 1996). The debate is driven by the concern that incumbents can use their market power and their vertically integrated structure to discriminate against competitors. Therefore, the legal framework already requires “functional unbundling”,<sup>14</sup> in particular the obligation to organize infrastructure and operation in separate organizational units or companies. Railway undertakings (RU) and infrastructure managers (IM) must have own statements of income and balances. Companies that run both infrastructure and railway services are further obliged to ensure independent decision making regarding essential functions like time-scheduling, allocation of rail paths and usage fees. Railways – integrated or not – must also have managerial independence from the state. Independent regulatory authorities control and ensure the enforcement of these rules.

As long as these legal requirements are met, member states are free to choose their market model. In European member states, a variety of governance models can be found. Hence, there are examples for railway systems that are partially unbundled but still vertically integrated and at the same time examples where the railway system is fully ownership unbundled. Under all structural models there are cases, which have successfully achieved a high degree of liberalization and others, which have not. According to the LIB Index 2011, a study that analyzes the degree of market opening in the various member states, the most advanced countries are the UK, Sweden (both have full separation models) and Germany (partial unbundling under a holding structure). At the same time, the LIB Index shows that besides the existing European law there are huge differences between the individual countries regarding the liberalization. In particular, a comparison across all member states indicates no correlation between the vertical structure and the market share and number of new market entrants.

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<sup>14</sup> European Commission, 2012, Directive 2012/34/EU;. Cf. in particular arts. 4, 6 and 7.

Besides the rather slow progress of the market opening of the national markets the rail sector also suffers from a difficult financial situation. In contrast to other network industries, e.g. the energy sector, the network fees do not cover the cost of operation and investments in the network. In Germany, for instance, network fees cover the cost of operation and maintenance, but only to some extent replacement investments and new constructions. For the most part, investments are funded by the government. Thus, it is an additional goal and also challenge of railway policy not only to ensure competition in railway services but also to safeguard investments in the infrastructure.

Early 2013 the European Commission launched proposals for a 4th Railway Package<sup>15</sup> with the overall goal (IA-Rail, 2013, p. 31):

“[...] to enhance the quality and efficiency of rail services by removing remaining legal, institutional and technical obstacles, fostering the performance of the railway sector and its competitiveness, in order to further develop the Single European Railway Area.”

This overall goal is broken down into three subgoals 1) removing administrative barriers, 2) opening the domestic rail passenger markets and 3) optimizing the governance of infrastructure management (IA-Rail, 2013, p.6). The latter is exactly the debate on the extent and form of vertical unbundling of network (Infrastructure Management, IM) and transport (Railway Undertakings, RU).

To address the optimization of the governance of infrastructure management, the European Commission provided an Impact Assessment (IA-Rail, 2013). With this IA-Rail the Commission argues that vertical unbundling is the most effective and efficient measure to spur competition and efficiency in the railway sector. Thereby, the Commission argues along two basic “challenges” (IA-Rail, 2013, p. 30, 33):

1. The efficient management challenge, including:
  - Ensure better coordination/alignment between the IMs and rail operators
2. Equal access challenge, including:
  - Prevent cross-subsidies
  - Disenable IM-functions as sources of discrimination

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<sup>15</sup> EU-Commission, 2013, “The fourth railway package – completing the single European railway area to foster European competitiveness and growth”, 31.01.2013, Brussels.

The two challenges establish the fundamental trade-off between competition and coordination. The equal access challenge aims to promote competition. The coordination or misalignment of incentives problem between the IM and rail operators (RU) are precisely the aforementioned negative by-effects of unbundling. The IA-Rail (2013, pp. 34 ff.) lists three options to address the coordination problem.

- Railway Undertakings (RU) participating in the administrative board or supervisory board of the IM.
- Coordination bodies.
- Financial incentives alignment, which supposedly could include cost- and revenue-sharing models.

The Commission suggests vertical ownership unbundling as the best measure to address the problems of equal access challenge (IA-Rail 2013, p. 56), although it acknowledges the lack of coordination. In the following we analyze the IA-Rail in more detail and compare with the experiences in electricity.

#### ***4.2 The Impact Assessment in more detail – parallels to the electricity sector***

Comparing the IA-Rail and the IA-Energy there are both similarities and differences. Both aim at fostering competition by creating equal access conditions. However, while promoting network investments was important in the IA-Energy, the IA-Rail stresses the improvement of system efficiency. Still, the IA-Rail (2013, pp. 48 ff.) also expects that unbundling will increase investment in infrastructure and transport operations. The investment effect is a difficult issue. As we have argued above, the theory on the relationship between unbundling and investment is ambiguous at best; the few available empirical studies seem to indicate that the effect may actually be negative: unbundling may lead to less investment. The experience in the electricity sector does not give a distinct picture either.<sup>16</sup> In the rail sector, the

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<sup>16</sup> Take for instance the independent transmission network owner TenneT. Owning the network in the northern parts of Germany, TenneT is responsible for connecting offshore windparks with the network. In 2012 it became apparent that TenneT is not able to finance this extension of the network. The Dutch government that holds the shares of TenneT rejected an increase in capital stock. In consequence, the German government decided that electricity users will have to contribute at extensions costs. In a report for the EU Commission, Roland Berger inter alia points to unbundling and notes (Roland Berger, 2011, p. 55) that „Smaller TSOs relatively new to the market due to recent unbundling often lack the necessary financing capabilities. They face the challenge of obtaining the required volumes of debt and equity at favourable conditions.” Basically, under current conditions with substantial investment requirements, companies need equity and debt but are by and large unable to raise

assessment of the effects of unbundling on investment decision as a strategic tool for discrimination is even less clear. Investment in rail infrastructure is to some extent state funded and also determined by requirements and restrictions set by the government: In those cases, scope for strategic behavior and discrimination is very limited and the question of unbundling is less relevant in either direction. But as far as own investment of the IM is concerned, the above described mechanisms are valid: An independent infrastructure manager may have an incentive to invest only the required minimum to uphold the quality but not the amount that would be necessary to improve the service of RU, if the IM cannot recoup the spill-over effects of improved services (cf. section 3 above). Still, the IA-Rail upholds the argument that integrated infrastructure managers only invest where this supports the integrated RUs.

Regarding the impact of unbundling on system efficiency, the Impact Assessment (IA-Rail, 2013) refers to the McNulty (2011)<sup>17</sup> report. However, somewhat surprisingly, it does not reflect the main insight of the McNulty report: far-reaching fragmentation causes flawed coordination leading to significant inefficiency. The task of the study was to analyze the inefficiency of the British rail system overall and to provide policy recommendations for improvement. Starting point for the McNulty study (2011, ch. 2.3.4) was the notion, that the British railway system is as much as 40% inefficient as compared to its peers (France, the Netherlands, Sweden and Switzerland). Principal “barriers to efficiency” are (McNulty, 2011, pp. 9 ff):

- Fragmentation of structure and interfaces
- Ineffective and misaligned incentives
- Fares structures do not send efficient pricing signals
- The industry’s legal and contractual framework is complex

These are powerful and critical words. Note the implicit line of argument: an interactive value chain (such as railways or an electricity system) needs seamless coordination to be optimal overall (which is different from the sum of separate parts); fragmentation requires that firm-internal coordination is replaced by external market coordination with a set of prices,

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internal equity. As unbundled TSOs cannot rely on capital from the parent company, they have to go on the market for external equity and debt. For a wide set of reasons explored by Roland Berger (2011) this is not at all unproblematic. Yet, we note that ownership may play a more important role for financing capabilities.

<sup>17</sup> There is a long version of the report and a management summary. Unless stated otherwise, we refer to the management summary.

contractual arrangements and markets. External market coordination turns out to be complex. Talking about misalignment costs as a result of separation (e.g. IA-Rail, 2013, p. 43), the European Commission acknowledges problems due to a high fragmentation of the value chain, but does not make any effort to evaluate the cost of such a fragmentation. Notably, this criticism is shared by the Impact Assessment Unit of the European Parliament (2013, p. 7), which notes:

“Arguments against the options chosen, such as the risk of misalignment and the loss of system efficiency resulting from institutional separation, or the advantages of national solutions adapted to national specificities, do not appear to be developed. The Commission simply argues that the risks of loss of synergies and economies of scope ‘will be mitigated by the enhanced coordination between IMs and infrastructure users as well as full implementation of the financial incentives foreseen by the recast’.”

In its description of the misalignment problems, the McNulty report focuses on the vertical interface between infrastructure and transport. The McNulty report (2011, pp. 10 ff.) continues with a large set of recommendations, amongst which:

“Closer alignment of route-level infrastructure management with Train Operating Companies (TOCs), at one or other of the following levels:

- minimum – cost and revenue sharing, and joint targets; or
- intermediate – joint ventures or alliances; or
- maximum – full vertical integration through a concession of infrastructure management and train operations combined.”<sup>18</sup>

These are important recommendations and practically show the downsides of unbundling. As already indicated, these are the exact issues that are discussed in the electricity sector. Like in the electricity sector, it is necessary to assess carefully whether further unbundling rules actually promote competition or whether they harm the sector. Note in particular the minimum recommendation above to improve possibilities of cost and revenue sharing, or taken together, profit-sharing. To quote the McNulty report (2011, p. 49): “It is vitally important that the infrastructure managers (IMs) and the train operators have a commercial interest in each other’s cost and revenues”. This stands in sharp contrast to unbundling rules, and ownership unbundling in particular. Indeed, as argued in section 3, we face a “regulation versus unbundling dilemma”: With unbundling, we should allow cost-, revenue- and profit-

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<sup>18</sup> The Train Operating Companies (TOCs) are the same as Railways Undertakings (RU).

sharing to be able to internalize spill-over effects; with strict regulation, we should allow joint ventures and (partial) vertical integration. Given the choice it is not immediately obvious that unbundling would be superior to regulation in terms of competitive effects and non-discrimination. If both are prohibited, we must expect that incentives are misaligned and the systems develop sub-optimally. We can observe these developments in the electricity sector – as illustrated above, if each stage of the value chain optimizes individually, the overall system may be sub-optimal.

There are also other examples from practice illustrating coordination problems. The Netherlands encountered the problem of flawed coordination and cooperation between the IM (ProRail) and the incumbent RU (Nederlandse Spoorwegen, NS), both fully unbundled. A background document published jointly by ProRail and NS, and supported by the Dutch government (ProRail & NS, 2012) explores problems and solutions. The report identifies five fields where cooperation and coordination are suboptimal (ProRail & NS, 2012, p. 4, 5): 1) infrastructure development, 2) timetable development, 3) capacity allocation, 4) track management and 5) stations. The problems that emerge are:

- No shared or agreed vision and (long term) goals
- Suboptimal organization and processes of infrastructure development, capacity allocation and track management.
- Complex allocation of responsibilities of station management.

These problems are similar to those identified by the McNulty report (see above): misaligned incentives, different strategic goals, no whole-system approach, governance structures to deal with conflicts are not explicit or too complex. The document also lists possible solutions (ProRail & NS, 2012, p.7); in particular, improvement of operational cooperation by two means:

- More explicit management of cooperation, and,
- More and better use of financial incentives, which includes penalties- and rewards-systems and the use of network-charging structure.

As a first step, ProRail and NS established a cooperation platform in July 2013.

In France, the government started a reform of the rail system. Until now, the railway has been vertically separated. The infrastructure was run by the RFF (Reseau Ferré de France) and the railway service by the incumbent SNCF (Société Nationale de Chemins de Fer). However, even though officially separated, the RFF has assigned some important functions of

infrastructure management to SNCF. After the railway reform, all functions relating to operation and maintenance shall constitute one unit, the SNCF constitutes another. Both business units shall be subsidiaries of a holding organization. This new structure aims at a better coordination and an alignment of interests.<sup>19</sup>

The literature is ambiguous on the effects of unbundling in railways. A study by Van der Velde et.al (2012) finds no evidence that vertical separation is necessary to achieve the benefits of competition; in contrast, the study underlines the pitfalls of misaligned incentives. It estimates ca. €6 billion/year additional cost associated with European-wide vertical separation, with no accompanying benefits. More specifically, Van der Velde et al (2012, p. 6) find that the cost of vertical separation increase both with traffic density and with the degree of mixed traffic.<sup>20</sup> This is intuitive: presumably, higher traffic density comes with higher coordination requirement, as does a more heterogeneous pattern of demand.

Further studies have been conducted. The interested reader may be referred to for instance Roland Berger (2012), Boston Consulting (2012), Finger & Rosa (2012) and Laabsch & Sanner (2012) for literature studies. By and large, the empirical literature is inconclusive, and suggests that there is no evidence of an unambiguous relation between the sector's performance and the governance model (i.e. the state of unbundling) of the sector.

## **5 Lessons learned and concluding remarks**

The European Commission's impact assessment of the energy and railway reform packages suffers from the same weakness: it fails to take into account the potential costs of unbundling, and in particular, the costs of flawed coordination. Vertical separation of network and supply activities may cause misaligned incentives in a fragmented system. As we have discussed, these costs can be persistent and significant. A proper cost-benefit-analysis must weigh the benefits against these costs before coming to an overall assessment. This paper discusses three sources of persistent cost of coordination: 1) the regulation versus unbundling dilemma, 2) optimal network charging is difficult and 3) parties act strategically. These sources of flawed coordination play a role in both electricity and railways systems.

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<sup>19</sup> For more information regarding the purpose and content of the railway reform compare to [http://www.gouvernement.fr/sites/default/files/fichiers\\_joints/presentation\\_-reforme\\_ferroviaire.pdf](http://www.gouvernement.fr/sites/default/files/fichiers_joints/presentation_-reforme_ferroviaire.pdf).

<sup>20</sup> Expressed as the share of freight traffic as compared to passenger traffic operating on the network.



In the old, pre-reform world with vertically integrated utilities, coordination was *internal* within one and the same firm. The incentives of different actors within the company were aligned at shareholder level. In the new world, enforced unbundling results in fragmentation with a large set of decentralized actors with widely different incentives; these need to be coordinated *externally* by a market mechanism. This is the key problem: a system of prices and contracts to arrange market coordination is as yet at best imperfect.

We discuss three sources of persistent flawed coordination and illustrate these with practical examples from electricity and railways. Firstly, the “regulation versus unbundling dilemma”. The network owner can leave a commercial activity to a third party and internalize spill-overs with revenue sharing, unless regulation prohibits this; or the network owner can undertake the commercial activity itself and make the profit on the commercial side, unless unbundling prohibits this. A problem arises if both strict regulation and strict unbundling apply. Taken together this is a “regulation versus unbundling” dilemma and can easily lead to inefficient outcomes. As both electricity and railway infrastructure will remain strongly regulated, application of fine-tuned revenue- and profit-sharing models will be limited.

Secondly, optimal network charging may relieve downsides of unbundling in theory, but is difficult to implement in practice. Network charging starts to develop from a financing tool to a signaling device. To make a fragmented world work, a differentiated set of prices is key for optimal coordination. However, this is easier said than done. Even if we know optimal charging systems, implementation in practice runs into many problems, not the least, due to regulation, competition policy and politics.

Thirdly, parties act strategically. The McNulty report (2011, p. 36) draws attention to “an unhelpful degree of short-termism”. Different actors will have different interests. Even if we streamline information exchange, we must expect strategic behavior. Economic literature is full of examples where asymmetric information creates opportunity for strategic behavior; electricity and railway systems are no different. Given the degree of sunk investment, long life duration and long planning processes, electricity and railway infrastructure are particularly vulnerable to strategic behavior. It should not come as a surprise that major investments, like an offshore power grid, are perceived to be risky. Contractual frameworks to align and enforce incentives are complex.

Issues for further research follow immediately. Firstly, we need more empirical studies on the cost of coordination; these are system costs accruing to society as a whole, which can be estimated with system benchmarking. Secondly, we need to design alternative governance models, which achieve a better balance between competition and coordination.

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