ECONOMIC REGULATION ASSESSMENT OF NETWORK INDUSTRIES: RAILWAY INFRASTRUCTURE MANAGEMENT IN ESTONIA

Raigo Uukkivi[1], Ott Koppel[2]

Abstract

Naturally monopolistic network industries are subject to regulation of access to market and charging in order to achieve optimal use of infrastructure and avoid the abuse of monopoly power. Relatively little is known what results does such regulation genrerate and whether it achieves objectives. Literature states that due to the context-specific nature of regulatory framework, *ex post* analysis and practical experiments are necessary to study the impact of economic regulation. In this paper, the authors provide analysis of the results of economic regulation of railway infrastructure management in Estonia. Regulatory objectives and targets from relevant policy sources are identified and indicators compiled to monitor results. This is followed by discussion and recommendations for further research.

Keywords: economic regulation assessment, network industries, public railway infrastructure, performance measurement

JEL Code: D42, L43, L92, R48

1. Introduction

Over the years, a vast amount of academic work has been done on the merits and shortcomings of regulation as a public policy tool. The theoretical discussion can be broadly divided into public-interest and private-interest categories. Public-interest approach bases its argument on the value-adding benevolent regulator that corrects market failure and, by doing that, improves social welfare. Private-interest theories disagree with the assumption of effective regulatory response due to numerous behavioural and informational flaws that benefit different interest-groups, and make it inefficient or impossible to achieve socially optimal outcome of a regulatory process. There is an ample of critique on both concepts, primarily relating to lack of ability to empirically test respective arguments. However, differences on the rationales and assumptions aside, there seems to be a widespread agreement in mainstream economic literature that the absence of a competitive market mechanism warrants certain level of regulatory intervention.

It is well established concept that a company with monopoly power tends to produce less and charge a higher price than socially optimal. Therefore, exploitation of monopolistic

[1] Raigo Uukkivi; MPA; Deputy Secretary General, Ministry of Finance of Estonia; Suur-Ameerika 1, 10122, Tallinn, Estonia; raigouuk@hotmail.com

[2] Ott Koppel; PhD; Research Centre of Logistics and Transportation, Department of Mechanical and Industrial Engineering, Tallinn University of Technology; Ehitajate 5, 19086, Tallinn, Estonia; ott.koppel@ttu.ee

dominance leads to welfare loss for a society. A government has a range of regulatory tools to tackle the monopolistic market structure and support effective competition in the industry. There are, however, certain industries where it would be impossible or feasible to enforce competition. Such industries, for example network utilities, are referred to as naturally monopolistic industries. Under the circumstances, economic regulation of market access and charging is imposed to reduce monopolistic behaviour and compensate for the absence of competition.

Economic regulation is complex and inherently costly, therefore, the results should be assessed with appropriate scrutiny, including whether they deliver the objectives of the regulation. Despite a wide range and long history of monopoly regulation in the developed countries, the number of empirical studies available is limited. Likewise, there are only few analysis that are relevant in Estonia's context. For example, Eerma (2013) focuses on institutional setups and sector specific regulation in certain industries in Estonia. Uukkivi *et al* (2014) provide an in-depth discussion on the institutional framework of five regulated network utility sectors (electricity, railways, water and sewage, gas, district heating) in Estonia, whereas Ots (2016) offers a commentary on price regulation practices in Estonian energy sector from the regulator's perspective.

In order to contribute to the discourse, the objective of this paper is to assess economic regulation of a utility sector in Estonia and to propose indicators to monitor the results of the regulation. The analysis builds on the framework established in Uukkivi *et al* (2014) and focuses on railway infrastructure sector as a case study. Railway infrastucture was chosen because the regulatory framework of railways in Europe is relatively standardised on the level of directives. Railway legislation, technical standard and the scope of the network in Estonia has not changed materially over the years and the number of regulated companies is small which reduces complexity.

Estonia as a country provides interesting context. It started its transformation towards market economy immediately after regaining independence in 1990 with a major overhaul of the former Soviet governance structures. The process was marked by very liberal economic policy, including extensive privatization of the state's assets in a short timeframe. Strategic infrastructure and utility companies were restructured within a decade and, in many instances, were privately owned. All those developments coincided with the country's accession to the European Union and harmonisation of domestic legislation with the *acquis communautaire* as well as with the European Union's own market liberalisation policies in a number of utility sectors. Due to these developments, Estonia was often among the early adopters of European Union's policies for market liberalisation and developed economic regulation in all network utility sectors with a wide range of regulatory interaction.

The approach of this paper is as follows. First, it discusses theoretical literature on economic regulation of natural monopolies and regulatory impact assessment. Secondly, the authors provide summary of the institutional setup and objectives of economic regulation of railway infrastructure management in Estonia. Finally, author's identify relevant policy objectives and establish corresponding indicators to monitor results of regulation.

2. Literature review

2.1 Discussion on economic regulation of a natural monopoly

The term *regulation* has been used loosely in academic literature and different taxonomies of the concept are proposed. This paper refers to *regulation* as a system of publicly mandated institutions and legally enforceable rules all operators in a sector are subject to. Therefore, the *regulation* covers both legislative domain (setting of the rules) and executive domain (enforcement of the rules) but does not include codes of conduct or other voluntary sector specific arrangements. The authors of this paper also subscribe to the widely used distinction between social and economic regulation (Viscusi, Vernon and Harrington 2005; Ogus 2004). Economic regulation is closely related to the concept of natural monopoly and adresses market access and charging in such industries *ex ante*. It should not be confused with competition or antitrust regulation that monitors market performance *ex post*.

The concept of competition is one of the important topics in academic debate of economic regulation. It is commonly assumed that the process of rivalry between informed and rational parties leads to the optimal efficiency of resources in terms of productivity and allocation. The perception of how competition affects market behaviours has evolved over time. Neoclassical approach to static market equilibriums required *perfect competition i.e.* a marketplace with perfectly informed buyers and sellers of homogenous products with perfectly free entry. Obiously such conditions do not exist in actual markets and an entirely satisfactory competitive standard – *effective competition* – has become a substitute to the pure theorist's textbook idea of perfect competition (Shepherd 1990: 305-306). Effective competition, however, has greater importance beyond productive and allocative efficiency. Kimmelmann and Cooper, for example, consider effective competition essential for *good market performance*, a cornerstone of fundamental values such as freedom of opportunity and proper function of democracy in a society (Kimmelmann and Cooper 2015: 406).

In some markets, effective competition is either absent or dysfunctional and needs to be supported through regulation or other alternatives. A market situation which particluarly requires for such public policy intervention is called „natural monopoly". According to the mainstream approach on natural monopolies, an industry is considered naturally monopolistic when its cost function is characterized by declining average costs per single output and cost subadditivity across multiple outputs. In order to deter market entry, economies of scale must also be associated with sunk costs. (Baumol 1977: 809, Baumol *et al* 1977: 352) Therefore, a naturally monopolistic industry presents both economies of scale and economies of co-production. Under such circumstances, the most efficient arrangement for a society is to have such market served by a single firm *i.e.* a monopoly is maintained but an appropriate framework is set up to to challenge monopolistic behaviour.
Unlike a „standard" monopoly, naturally monopolistic industry is defined by the production technology and not the number of companies in the market. It is the capital intensity and sunk costs of investment that create natural barriers to entry to such

industries. Moreover, regulatory barriers are often in place due to considerations for achieving better allocative and productive efficiency.

Mosca provides an excellent summary of academic discourse on natural monopolies. According to that, natural monopolies typically occur in two types of productions. The first is described by the need for a large infrastructure, such as transport networks and some public utilities. The second type of natural monopoly can be explained by the presence of network effects. (Mosca 2008: 324) Liebowitz and Margolis explain that positive network effects are very similar to conventional firm-level economies of scale. If larger networks have idefinitely increasing advantage over smaller networks then we have entered the realm of natural monopoly. (Liebowitz and Margolis1998: 672)

In general, network utilities like transmission and distribution of electricity and gas, disctrict heating, water and sewage, railway infrastructure etc. are commonly considered in academic literature as examples of natural monopolies. Moreover, some authors argue that such utilities are natural monopolies also due to essential importance to the functioning of society and influence they have on other economic sectors (Hertog 2010: 2) or due to the complexity of their operations (Cogman 2001: 2).

Regulation is foremost a political act (Braeutigam, 1989: 1299), thus the evolution of economic regulation of naturally monopolistic industries has been ambivalent. Governments used to provide utility services through own apparatus in order to achieve economies of scale and cross-subsidize between customer segments. There have been several shifts of deregulation and reregulation among the European Union and the OECD countries that have changed the institutional structure and the way industries operate. Pera explains that deregulation and privatization started in the end of 1970s by governments seeking more reliance on market forces and competition. In the United States, many industries with economic regulation (especially transport, energy, telecommunications) saw complexity of rules abolished and regulatory burden on companies reduced. In Europe, deregulation was accompanied with privatization of public enterprises. The reforms were focused on achieving more efficient charging mechanism, introduction of market based stimulae, and search for better ways of managing natural monopolies. (Pera 1989: 160, 165) Detailed overview of how policy intitiatives on restraining trade unions, reducing state subsidies, supporting innovation and efficiency etc. reformed economic regulation landscape in the United States and Europe is provided by Hahn (1990), Kahn (1990), Newberry (2000) and Winston (1998). Today, economic regulation of network utilities is a common approach among the European Union and the OECD countries.

Economic regulation is a complicated interaction between stakeholders who have varying and sometimes conflicting interests. A regulated network utility strives to maximize profit in the short term whereas consumers demand high quality for low prices. Also regulators and politicians have their own agendas that are not always aligned. Leaver describes how regulators want to avoid public criticisms which occasionaly leads them to behave inefficiently in the price reviews (Leaver 2009: 573). Lim and Yurukoglu note the time-inconcistency problem as regulators promise a fair return on investments *ex ante*, but have no motivation to keep the promise after substantial investments have been

made (Lim and Yurukoglu 2018: 2). As a result, changing political realities can systematically affect decisions that regulators make and influence productive and allocative efficiency in an industry.

Regulating an industry sets incentives and disincentives to companies affecting their behaviour. Rational actors will anticipate regulatory developments and adapt their decisions and activities accordingly (Kydland and Presscott 1977, Gilbert and Newberry 1994). For example, price regulation methodology, level of scrutiny that a regulator imposes on costs, or the rate of return it allows on investment will have effect on cost of capital of utilities, incentive to invest in new technologies etc.

Maintaining a regulatory framework incurs substantial costs for the society. A regulated company has to contribute time and resources, adjust internal structures and comply with operational and informational requirements. As the company tries to capitalize on the information assymetry it has over costs and technology, a regulator has to develop a corresponding approach of monitoring and enforcing compliance. Review of cost structures and determining rate levels is a time-consuming process that requires many resources.

2.2 Objectives of regulation and assessment of regulatory outcomes

The fact that a regulation seeks to change behaviour and entails a complex system of interactions makes it nearly impossible to foresee the impact of implementing a regulation *ex ante*. Therefore, assessment of policies *ex post* is particularly important to undestand what works and whether the objectives of regulation are met or not. Real reform of regulation requires promoting a culture of regulatory evaluation and experiments (Greenstone 2009: 123). The popular concept of „policy cycle“ that illustrates policy making in different phases is appropriate to explain this. Howlett, for example, divides policy cycle into five steps: setting agenda, formulating policy, decision making, implementing policy and assessing policy (Howlett *et al* 1995:12). Assessment as the last phase in policy making aims to establish how a policy has performed in terms of reducing the problem.

The European Union and the OECD have been promoting assessments of regulations and published several guidelines on best practices. Yet establishing such feedback loops is complicated and poses a challenge for many reasons. First, the difference between monitoring policy implementation and evaluation of policy impact should be noted. Monitoring relates to identification of what results a policy delivers whereas evaluation determines whether the policy is relevant, effective and efficient (Segone *et al* 2008: 7-8). Second, a number of varying taxonomies are proposed for analysis of policy impact in theoretical literature. The following figure (Figure 1) refers to the approach proposed by Coglianese (2012).

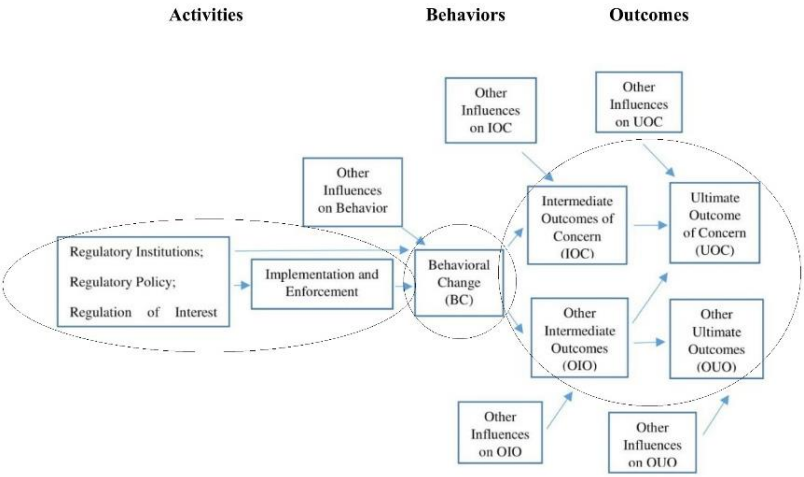

Figure 1. Causal map of regulation and its effects
Source: Authors' modification from Coglianese 2012: 21

Coglianese divides regulatory interaction into three core categories: regulation, behaviours and outcomes. The exercise of evaluation can be applied in the same manner across all categories: evaluation of how well a regulation is administered (activity); evaluation of compliance (behavior), and evaluation of outcomes. Outcome-based studies can additionally be differentiated based on the core features of outcome evaluation: a. indicators as empirical measures of outcomes and b. assessment of the extent to which the regulation has caused any of the observed changes in indicators (outcomes). To say that a regulation is effective is to attribute it to positive changes in indicators. (Coglianese 2012: 14-15)

A set of indicators is a tool for identifying the outcomes of regulation. Eurostat guidelines describe indicators as „road signs" of policy making that help to understand complex realities, assess where processes are heading and if goals are to be reached. These are measures that condense relevant information on policy to facilitate assessment. (Eurostat 2017: 9-10) Indicators should provide „evidence" that is expected to support conclusion (Oxman *et al* 2009: 3). Lomas also stresses the context-sensitive rather than scientific nature of evidence in social sciences. This means that any evidence has little meaning unless adapted to the circumstances of its application. (Lomas *et al* 2005: 4)

It is crucial to select appropriate set of indicators that are relevant to the regulatory matter and for which observable data is available. Coglianese puts that any selection of indicators must always be based on the purpose of the evaluation. When conducting evaluation, the selection of indicators will depend on regulatory objectives because defining something as a problem cannot be accomplished without reference to value choices. Because of this very reason, the evaluation of a specific regulation should be

guided by the concerns or objectives of policy makers setting up that regulation. In the absence of a specific problem, the discussion of indicators for regulatory evaluation will be abstract. (Coglianese 2012: 17-20) Any assessment of a regulation should first identify the potential users of performance measures and then tailor those measures according to the users needs (Metzenbaum 1998: 53).

The context-specific nature of regulatory outcomes and indicators leads to a question whether particular objectives of economic regulation of network utilities could be formulated that apply in every context? Theory holds that economic regulation of a monopoly aims to contain monopolistic market failure and achieve the resource allocation and production efficiency similar to effective competitive market. Obviously more specific objectives will vary, however, since network industries are strategically important and support other economic sectors and society as a whole, operational sustainability of a regulated company is somewhat a universal goal that every regulation should consider. If the company is not able to function, there is no service to the consumers.

It is obvious that economic regulation is redistributive by nature and a range of trade-offs (in the form of financial, political, social, economical gains, pressures and constraints) take place between different interest-groups. Therefore, more specific goals and indicators for regulatory performance are likely to differ country by country. Investors seek to maximize profits, whereas consumers have obvious interersts in security of supply, quality of service and lower prices. Yet consumers are not homogenous and sometimes their interests contradict as some groups are cross-subsidized by others. Yarrow argues that certain objectives of regulation can relate to specific problems of an industry and change over time. For example, regulation may be initiated due to suboptimal efficiency and performance of a company when taxpayers or customers bear the burden of excessive costs. (Yarrow 2008: 6-7). Eventually, it is the regulator that must strike a right balance between the interests of customers and a company. After all, the conflict of objectives is a pervasive feature of policy debates (Helm 2006: 171), whereas both policy and politics affect regulation and change outcomes in the economy (Kimmelmann and Cooper 2015: 404).

3. Analysis of economic regulation of railways in Estonia

3.1 Institutions and legislation of railway sector in Estonia

In the following chapter, the authors of this paper assess the results of economic regulation with the sectoral case study of railway infrastructure management in Estonia. The regulatory framework for railway infrastructure management in question was established in Estonia in 2004 and has produced a reasonable volume of regulatory interaction inherent the analysis and this study. First, summary is provided on institutional design of relevant state institutions, regulated companies and main provisions from Estonian railway legislation. Comprehensive outline on the evolution of economic regulation and respective institutions in railway sector in Estonia is available in Uukkivi *et al* (2014). Then, country specific regulatory objectives in railway sector are

identified from relevant legislation and other policy sources, and finally, appropriate indicators are proposed based on the objectives to assess impact of regulation.

Railway infrastructure management in Europe has traditionally been organised by state-owned or state controlled entities. Decades of monopolism without any threat of competition resulted in very low levels of productive and allocative efficiency of railway management, and accumulated huge deficits funded by the public budget. This proved the main impetus for sequential initiatives of economic regulation of railways in Europe. In order to increase the commercial viability of railway transport and promote modal shift from roads to railway, policies of the European Union have resulted in a gradual separation of the state administration and railway business, as well as vertical disintegration of monopolistic and inherently competitive railway operations. Although most of the railway network in Europe is still controlled by the former infrastructure monopolies, provision and charging of railway infrastructure management services in the European Union is more regulated than any other utility sector. Vertical unbundling is the central structural measure that allows for efficient use of existing railway infrastructure by providing access to it to all railway traffic operators for a fee payable to infrastructure manager.

European Union railway directives are an important source of regulation that Estonia must adhere to, principles and provisions laid down in Estonian railway act fully comply with the European Union railway policy. Estonian railway legislation considers main railway network as a natural monopoly and imposes restrictions on the property rights of public railway infrastructure in order to restrain monopolistic practices on access to the infrastructure and charging. After the adoption of European Union railway directives and opening up railway traffic operations to competition, Estonia required to vertically separate provision of railway transport services from infrastructure management.

There are two infrastructure managers of public railway network in Estonia: Eesti Raudtee AS (Estonian Railways) and Edelaraudtee Infrastruktuuri AS (South-West Railways Infrastructure). Both companies operate railway network that has been nominated as public interest by law and are therefore subject to economic regulation of access to the network and charging. Whilst Eesti Raudtee is 100% owned by the state Edelaraudtee is owned by private investors. Eesti Raudtee and Edelaraudtee had affiliated entities operating railway traffic, therefore, functions of capacity allocation and setting of infrastructure fee have been transferred to the independent body, Estonian Technical Regulatory Authority. Due to that fact, Estonian Competition Board acts as the National Regulatory Authority as stipulated in the European Union directives. Ministry of Economic Affairs and Communications of Estonia (MoEAC) is responsible for setting railway policy and making infrastructure financing agreements with railway infrastructure managers.
The price that a railway infrastructure manager can charge from railway transport companies to fund its infrastructure is regulated in detail by a specific section of the legislation, railway infrastructure charging methodology. It is rate-of-return type of approach and it has been in place almost unchanged with limited number of minor modifications since 2004. In principle, the methodology regulates the level of costs (operating, overheads, depreciation) that can be passed on to customers and a return that

a railway infrastructure manager can earn from its fixed assets. Methodological approach to railway infrastructure charging is similar to that of other network utility sectors in Estonia but the application of fee period is different. Estonian Technical Regulatory Authority is obliged to set an annual fee for railway infrastructure and renew it every year, whereas Estonian Competition Board sets fees that do not have a defined term. Those are valid until the new fee is set.

3.2 Regulatory objectives of economic regulation of railways

Ex post assessment of regulation requires to identify objectives *i.e.* the problem what the regulation should solve. After that, appropriate set of indicators should be chosen to monitor the outcomes of regulation. There are a number of sources in public policy that have the legitimacy to define and set such objectives: legislation, policy strategies, declarations by politicans or authorities responsible for particular domain (ministry, regulator). In order to identify regulatory objectives of railway regulation in Estonia, the authors of this paper analysed Estonian railway acts and railway infrastructure charging methodologies, National Transport Development Plan 2014-2020, fee decisions of Estonian Technical Regulatory Authority and infrastructure financing agreements between the MoEAC and railway infrastructure manager.

Railway act defines overall operational and financial objectives for railway infrastructure management. Those objectives are (a) provide railway transport operators non-discriminatory access to public railway infrastructure with regard to services, charges etc. (§ 7 pt 1), (b) ensure operational safety of the railway network, (c) keep the network operational for railway traffic to use (§ 34 pt 1), and (d) maintain the financial stability of a railway infrastructure manager by balancing revenues and costs at least over the five-year period (§ 49^2 pt 5). It is noted that the act does not provide any specific targets.

Railway infrastructure charging methodology outlines detailed technical procedure around the calculation of railway infrastructure fee. The methodology scrutinises the allocation of costs and assets between services, elimination of waste etc, however, it does not set any specific targets to the company or regulator to meet. The authors of this paper studied regulatory decisions of the Estonian Railway Administration, the Estonian Railway Inspectorate and the Estonian Technical Regulatory Authority relating to the process of setting infrastructure charge based on the charging methodology since 2004. There is a distinctive pattern in the explanatory notes alluding that the regulator insists on strong cost discipline, however, no firm targets have been established for the regulated company to achieve.

National Transport Development Plan 2014–2020 outlines a number of declarations that can be considered objectives of the economic regulation of railway infrastructure management. It declares that railway freight transport cannot absorb the current level of railway infrastructure fees and they need to become more competitive, also the financial viability of Eesti Raudtee is under pressure. Railway passenger operations need to increase speeds up to 120 km/h and exceed road transport alternatives. Infrastructure investments should be directed to maintaining network capacity, safety and quality of operations. (National Transport Development Plan 2013: 53)

Infrastructure financing contracts have only been established between the MoEAC and Eesti Raudtee. The contracts in such format with the railway infrastructure manager were put in place in 2016 and renewed annually, they aim to balance the expenditure and revenue of railway infrastructure management under „normal business conditions“ over the five-year period. Importantly, the conctracts define clear areas of priority and establish targets. Contract pt 1.4.1 outlines these priorities as:

- operating speed of railway line, reliability of service and consumer satisfaction;
- capacity of the railway network;
- asset management;
- volume of operations;
- safety performance;
- environmental protection.

Annex of the contract identifies annual targets and is renewed every year. Comprehensive summary of regulatory objectives of railway infrastructure management is presented in Table 1.

Table 1. Regulatory objectives of railway infrastructure management in Estonia

Source	**Objective**	**Target**
Railway act	1. Non-discriminatory access to infrastructure 2. Railway safety 3. Service provision reliability 4. Financial stability	1. None 2. None 3. None 4. Balanced revenues and costs over 5 year periods
National Transport Development Plan 2014-2020	1. Competitive fee level for freight transport 2. Increase of passenger traffic service speeds 3. Safety performance, capacity and quality	1. Fee level should not increase 2. 120 km/h and exceed road alternatives 3. Current level should be maintained
Infrastructure charging methodology	1. Correct application of methodology and cost discipline	1. None
Infrastructure financing contract	1. Operational speeds on the network 2. Service provision capability 3. Network capacity 4. Asset management/cost discipline 5. Safety 6. Declares no objectives for customer satisfaction, volume of operations and environmental safety	1. Yes. Detailed 2. Yes. Number of breakdowns 3. Yes. Detailed 4. Yes. 5. Yes. Number of level-crossings to be upgraded 6. N/A
Fee decisions	1. Cost discipline	1. None

Source: authors’ compilation

3.3 Discussion of regulatory outcomes of economic regulation of railways

3.3.1 Regulatory indicators

Previous section of this paper identified regulatory objectives of economic regulation of railway infrastructure management in Estonia. In order to collate evidence on whether those objectives have been met and what the outcomes are, a set of indicators needs to be compiled. The following discussion focuses only on Eesti Raudtee and scopes out Edelaraudtee. This is because the latter is solely used for passenger transport funded from public service obligation (PSO) contracts, also, the state has not signed an infrastructure financing contract with Edelaraudtee. Eesti Raudtee presents a wider mix of freight and passenger traffic and also has the status of „railway administration" with regard to the non-EU countries.

Stenström proposes a system for performance measurement of railway infrastructure management that differentiates between two groups of indicators: managerial group and condition group. Managerial group constist of technical indicators, organisational indicators, economic indicators and HSE (health, safety and environment) indicators, whereas condition group displays the status of different technical subsystems of railway infrastructure. (Stenström *et al.* 2012: 6-8) Current analysis focuses on managerial indicators as those are relevant for the purpose of monitoring regulatory outcomes. When defining regulatory objectives, policy makers and regulators usually focus on high level overall performance of a regulated company as opposed to detailed technical characteristics of infrastructure. Moreover, if infrastructure technical systems fail then performance levels are also affected. One can thus argue that condition level aspects are included in the managerial indicators.

Indicators for economic regulation of railway infrastructure management in Estonia are presented in Table 2. Indicators and targets for specific infrastructure management domains were sourced from infrastructure financing contracts or other sources of regulatory objectives. In the absence of predefined indicators, the authors propose them provided that relevant data is available. The analysis of this paper covers the period from 2013 onwards when the business concern structure of Eesti Raudtee was abolished and vertical separation between railway infrastructure management and railway transport operations was finalised. It should be mentioned, however, that the state has set clear targets for railway infrastructure manager only for the last two years.

Table 2. Regulatory indicators of railway infrastructure management on Eesti Raudtee infrastructure 2013-2017

	2013	2014	2015	2016		2017	
	actual	actual	actual	target	actual	target	actual
Network speed (km/share with 120 km/h)	500 (74%)	529 (78%)	529 (78%)	541 (80%)	556 (82%)	556 (82%)	571 (84%)
Network capacity (train pairs/day)[3]	160	160	160	160	160	160	160
Number of breakdowns	405	418	258	320	257	320	258
Total expenditure (million EUR)	55,08	54,43	54,13	less than 53,91[4]	53,43	less than 56,11[5]	53,04
Volume of operations (million train-km; million freight tonnes)	5, 97 (24,4)	6, 45 (19,3)	5, 94 (15,4)	N/A	5, 71 (12,5)	N/A	5, 66 (12,4)
Work safety (number of incidents; working days lost)	1 (24)	5 (224)	1 (0)	N/A	3 (35)	N/A	4 (91)

Source: authors' analysis

3.3.2 Technical and organisational indicators

Technical and organisational indicators are related to reliability, availability and maintainability of railway infrastructure management (Stenström et al. 2012: 6-7). With reference to the regulatory objectives of railways in Estonia, service provision reliability and operational speed on railway network fall into this category.

Proportion of railway main lines with maximum operational speed (120 km/h) is a proxy indicator of the technical condition of railway because maintenance deficiencies usually translate to speed restrictions. One can note that targets and levels of the indicator have steadily increased over the past five years. The second indicator measures the flexibility of railway capacity. Level of capacity demanded by the state and respectively provided

[3] Railway capacity is calculated for each individual line. The table indicates maximum capacity of Tapa-Lagedi-Ülemiste which is the most heavily used railway segment in Estonia. The actual capacity allocated on the mentioned segment for 2017/2018 traffic period is 38 train pairs/day (Eesti Raudtee web-site).

[4] Less than CPI–0,5% from previous year

[5] Less than 5% increase from previous year

by railway infrastructure manager has remained flat. Railway capacity on Eesti Raudtee, however, is abundant as available capacity on the most heavily used main line exceeds actual utilization by a factor of four. Number of breakdowns affecting train schedule is the third indicator in this segment. Overall, the number of breakdowns has been falling and targets for the last two years have been achieved by the infrastructure manager. The state does not set objectives on customer satisfaction about the infrastructure service and respective indicators cannot be defined in this paper due to the lack of relevant data.

3.3.3 Economic indicators

Economic indicators address cost-efficiency and financial viability of railway infrastructure management. Although all policy sources of railway regulation in Estonia stress the need for cost discipline and financial stability of the regulated company, total expenditure[6] of railway infrastructure management is the only indicator defined in infrastructure financing contracts. Total expenditure levels of Eesti Raudtee have been falling moderately over years in nominal terms, but set targets are not challenging considering the objectives and allow for up to 5% annual increase. The state has not set objectives or targets on the volume of operations on the railway infrastructure. The authors therefore provide an indicator based on train-kilometers and total freight volume which is considered an appropriate metric reflecting both the intensity of passenger and freight traffic. One can note that while freight volume has more than halved over the past five years, the amount of train-kilometres has decreased marginally. Therefore, passenger traffic has substituted freight in this metric. Also, cost efficiency of infrastructure management relative to the volume of railway traffic has somewhat deteriorated. Due to the fact that railway infrastructure manager's total budget is set by the regulator, variation between the forecasted and actual expenditure could also be considered as regulatory indicator in future.

3.3.4 Health, safety and environment (HSE) indicators

HSE indicators are an important perspective to railway infrastructure management as poor record in this domain can have serious implications to reliability of supply and performance. For that reason, general HSE requirements are usually set on the level of legislation. All sources of regulatory objectives of railway infrastructure management in Estonia state the importance of HSE but only infrastructure financing contract sets clear targets. In the contract, the MoEAC and Eesti Raudtee agree on the number of level crossings and pedestrian crossings to be upgraded every year. While Eesti Raudtee has achieved targets 2016 and 2017, it is difficult to estimate the impact such investments have on safety. In principle, accidents on railway level crossings are caused by the breach of traffic code by road traffic or pedestrians. Therefore, improvement of safety on level crossings depends on a variety of technical, social and behavioural aspects well beyond the domain of railway infrastructure management. The state has not set regulatory objectives on occupational safety thus the authors provide an aggregate indicator on the number of incidents and working days lost because occupational safety is a domain where

[6] Total expenditure consist of operating expenditure and capital expenditure. Reasonable business profit is not included.

the regulated company can directly impact outcomes. One can note that the overall level of incidents over the five years has been low and fluctuations year on year are inconclusive.

4. Conclusions

The objective of this paper is to assess economic regulation of naturally monopolistic network utility sector using railway infrastructure management in Estonia as a case study. Any regulation must be evaluated relative to its objectives. Therefore, in order to identify the objectives of economic regulation of railway infrastructure management, the authors analysed railway legislation, policy and strategy documents, and practical implementation of economic regulation in Estonia. The study reveals that although the framework of economic regulation of railway infrastructure management has been in place since 2004 and has not changed much over the years, there is no institutionalised mechanism in place to monitor how the regulation works. Objectives of economic regulation of railway infrastructure management in Estonia are difficult to identify and are mostly conceptual or vague. Cost discipline, safety, network capacity and quality of service are stated in a number of policy documents over the years but absence of clear targets does not allow the measurement and assessment of outcomes of the regulation.

It was only in 2016, when specific objectives and targets of economic regulation were introduced in railway infrastructure financing contracts between the MoEAC and Eesti Raudtee with 8 areas identified as priorities. This paper allocates these objectives into technical-organisational, economic and health-safety-environmental categories, and proposes indicators to monitor performance against targets for the five year period 2013-2017. Analysis demonstrates that most of the regulatory objectives address safety and quality of railway infrastructure, there is one objective on economic performance and one on safety performance. Currently no objectives or targets have been set on the volume of operations, customer satisfaction and environmental safety of railway infrastructure management.

Technical indicators monitor the extent of speed restrictions on the infrastructure, network capacity and number of breakdowns that affect train schedule. All targets have been achieved by Eesti Raudtee and it is noted that the quality indicators have been improving. However, the relevance of setting targets for maximum network capacity is questionable because only a fraction of available capacity is utilized on Eesti Raudtee infrastructure.
Economic viability of railway infrastructure management and reducing costs for customers is an important consideration of economic regulation in railway policy documents. Clear objectives are still few and targets for total expenditure rather unambitious. The authors propose indicators for safety and volume of operations on infrastructure, whilst noting that the cost efficiency of infrastructure management has deteriorated over the last five years.

Finally, the authors highlight the need for further research towards a more holistic approach to measuring the effectiveness of economic regulation of railway infrastructure management in Estonia. A more comprehensive mechanism of objectives, targets and

indicators is needed to achieve this. The approach should be agile and responsive to industry developments, cover all important aspects of the economic activity and enable benchmarking railway infrastructure managers and network utilities from other sectors.

References

1. **Baumol, W. J.** (1977), On the proper cost test for natural monopoly in a multiproduct industry. American Economic Review 67, pp. 809–822
2. **Baumol, W. J.; Bailey, E. E.; Willig, R. D.** (1977), Weak invisible hand theorems on the sustainability of multiproduct natural monopoly, The American Economic Review 67, 3, pp. 350–365
3. **Braeutigam, R. R.** (1989), Optimal policies for natural monopolies. In Handbook of industrial organization. Vol. 2. Richard Schmalensee and Robert D. Willig, eds. Elsevier Science Publishers B.V.
4. **Coglianese, C.** (2012), Measuring regulatory performance: evaluating the impact of regulation and regulatory policy. (Expert Paper, 1.) OECD
5. **Cogman, D.** (2001), Allocation of access rights to rail network infrastructure. Research Paper (Graduate School of Business, Stanford University) 1690, 1–48. Available online at <https://www.gsb.stanford.edu/gsb-cmis/gsb-cmis-download-auth/317646>. Accessed on 10.03.2018
6. **Eerma, D.** (2013), Possibilities of economic policy for regulation of sector-specific markets in small country: the case of Baltic countries. Saarbrücken, Germany: LAP LAMBERT Academic Publishing.
7. **Eesti Raudtee web-site**, Available online at http://www.evr.ee/**.** Accessed on 20.03.2018
8. **Eesti Raudtee annual reports 2013-2017**; Available online at <http://www.evr.ee/ettev%C3%B5ttest-majandusaasta-aruanded>. Accessed on 20.03.2018
9. **Eesti Raudtee network statements 2015-2018;** Available online at <http://www.evr.ee/kliendile-ja-partnerile>. Accessed on 20.03.2018
10. **Estonian Technical Regulatory Authority**; capacity allocation data 2005-2017; Available online at <https://www.tja.ee/et/valdkonnad/raudteeinfrastruktuuri-labilaskevoime/jaotatud-labilaskevoime>. Accessed on 20.03.2018
11. **Eurostat** (2017), Towards a harmonised methodology for statistical indicators, Part 3 – Relevance of Indicators for Policy Making, 2017 edition, European Union
12. **Gilbert, R. J.; Newbery, D. M.** (1994) The Dynamic Efficiency of Regulatory Constitutions. The RAND Journal of Economics, 1994, pp. 538–554.
13. **Greenstone, M.** (2009), Toward a Culture of Persistent Regulatory Experimentation and Evaluation. In David Moss & John Cisternino, eds., New Perspectives on Regulation, The Tobin Project, Cambridge, MA.
14. **Hahn, R. W.** (1990), Regulation: Past, Present, and Future. Harvard Journal of Law & Public Policy, Vol. 13, Issue 1
15. **Helm, D.** (2006), Regulatory Reform, Capture, and the Regulatory Burden. Oxford Review of Economic Policy, 22(2), pp. 169-185
16. **Hertog, J. den.** (2010), Review of economic theories of regulation. Discussion Paper Series nr. 10-18, Utrecht School of Economics

17. **Howlett, M.; Ramesh, M.** (1995), Studying Public Policy: Policy Cycles and Policy Subsystems. Toronto, Oxford University Press, 1995
18. **Kahn, A. E.** (1990), **Deregulation: Looking Backward and Looking Forward.** Yale Journal of Regulation, Issue 2, Vol. 7, pp. 325-354
19. **Kimmelmann, G.; Cooper, M.** (2015), Antitrust and Economic Regulation: Essential and Complementary Tools to Maximize Consumer Welfare and Freedom of Expression in the Digital Age. Harvard Law and Policy Review, Vol. 9, pp. 403-441
20. **Kydland, F. E.; Prescott, E. C.** (1977), Rules Rather than Discretion: The Inconsistency of Optimal Plans. The Journal of Political Economy, 1977, pp. 473–491
21. **Leaver, C.** (2009), Bureaucratic Minimal Squawk Behavior: Theory and Evidence from Regulatory Agencies. American Economic Review, Vol. 99, pp. 572–607
22. **Liebowitz, S. J.; Margolis, S. E.** (1998), Network effects and externalities. In The New Palgrave's Dictionary of Economics and the Law. London: MacMillan, pp. 671–675
23. **Lim, C. S. H.; Yurukoglu, A.** (2018), Dynamic Natural Monopoly Regulation: Time Inconsistency, Asymmetric Information, and Political Environments. Journal of Political Economy, Vol. 126, Issue 1
24. **Lomas, J.; Culyer, T.; McCutcheon, C.; McAuley, L.; Law, S.** (2005), Conceptualizing and Combining evidence for health system guidance. Ottawa, Canadian Health Services Research Foundation, 2005.
25. **Metzenbaum, S.** (1998), Making Measurement Matter: The Challenge and Promise of Building a Performance-Focused Environmental Protection System, Brookings Institution, Washington, D.C., Available online at <https://www.brookings.edu/wp-content/uploads/2016/06/metzenbaum.pdf> Accessed on 10.03.2018.
26. **Mosca, M.** (2008), On the origins of the concept of natural monopoly: Economies of scale and competition. The European Journal of the History of Economic Thought, Vol. 15, No. 2, pp. 317-353
27. **National Transport Development Plan 2006-2013**; Ministry of Economic Affairs and Communications of Estonia. Available online at <https://www.riigiteataja.ee/aktilisa/0000/1278/4604/12784610.pdf>. Accessed on 10.03.2018.
28. **National Transport Development Plan 2014-2020**; Ministry of Economic Affairs and Communications of Estonia. Available online at <https://www.riigiteataja.ee/aktilisa/3210/2201/4001/arengukava.pdf>. Accessed on 10.03.2018.
29. **Newbery, D. M.** (2000), Privatization, Restructuring and Regulation of Network Utilities. (The Walras-Pareto Lectures, 1995), MIT Press, 2000
30. **Ogus, A. I.** (2004), Regulation: legal form and economic theory. Hart Publishing.
31. **Ots, M.** (2016), Practical Implementation of Price Regulation in Energy Sector. Tallinn University of Technology, TUT Press
32. **Oxman, A.; Lavis, J. N.; Lewin, S.; Fretheim, A.** (2009), Support tools for evidence-informed health policy making (STP) I: What is evidence-informed policy making? Health Research Policy and Systems 7 (Suppl I): SI, 2009

33. **Pera, A.** (1989), Deregulation and Privatization in an Economy-Wide Context. OECD Journal: Economic Studies, Paris, pp. 159-204
34. **Railway Act** (Raudteeseadus); 23.02.1999; RT I 1999, 29, 405. Available online at <https://www.riigiteataja.ee/akt/77324>. Accessed on 10.03.2018.
35. **Railway Act** (Raudteeseadus); 19.11.2003; RT I, 16.05.2017, 3. Available online at <https://www.riigiteataja.ee/akt/116052017003>. Accessed on 10.03.2018.
36. **Railway infrastructure charging methodology**; decree of the minister of economic affairs and communications 01.06.2004 nr. 144; RTL 2004, 74, 1213. Available online at <https://www.riigiteataja.ee/akt/767103>. Accessed on 10.03.2018.
37. **Railway infrastructure charging methodology**; decree of the minister of economic affairs and communications 28.04.2008 nr.32; RTL 2008, 36, 522. Available online at <https://www.riigiteataja.ee/akt/13304518>. Accessed on 10.03.2018.
38. **Railway infrastructure charging methodology**; decree of the minister of economic affairs and communications 19.08.2016 nr. 51; RT I 24.08.2016, 1. Availabe online at <https://www.riigiteataja.ee/akt/124082016001>. Accessed on 10.03.2018.
39. **Railway Infrastructure Financing Contract** (concluded between Ministry of Economic Affairs and Communications of Estonia and Eesti Raudtee 28.12.2015)
40. **Segone, M.; Pron, N.** (2008), The role of statistics in evidence-based policy making. UNECE Work Session on Statistical Dissemination and Communication, Geneva, 13-15 May 2008
41. **Shepherd, W. G.** (1990), Mainstreams industrial organization and 'new' schools. Revue economique 41, 3, pp. 453–480
42. **Uukkivi, R.; Ots, M.; Koppel, O.** (2014), Systematic approach to economic regulation of network industries in Estonia. Trames : Journal of the Humanities and Social Sciences Vol 18, No 3, 2014 Estonia, pp. 221-241
43. **Viscusi, K. W.; Vernon, J. M.; Harrington, J. E. Jr.** (2005), Economics of Regulation and Antitrust", Cambridge, MA, MIT Press
44. **Winston, C.** (1998), U.S. Industry Adjustment to Economic Deregulation. Journal of Economic Perspectives, Vol.12, No. 3, pp. 89-110
45. **Yarrow, G.; Decker, C.; Keyworth, T.** (2008), Report on the impact of maintaining price regulation. Regulatory Policy Institute, Oxford, United Kingdom