

THE LIGHTHOUSE IN ESTONIA: THE PROVISION MECHANISM OF “PUBLIC GOODS”

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Abstract

The purpose of this paper is to discuss the incentive structure or the mechanism that defines the private and public provision of public goods. Analytic narratives are used based on historical studies of the provision of lighthouse services in Estonia. The latter allows a theoretical discussion over the boundaries of private initiatives in public good provision and also allows a dialogue with Coasean principles. Findings show that there is no clear-cut division between private and public provision, rather throughout history there have been some combinations of private and public provision. Private agents are only able to provide lighthouses with the aid of supportive institutions – rewards for lighthouse owners and credible threat of punishments to the ship owners. Rewards must be at least as big as costs of exclusion, e.g. central collection of light dues; punishment of the ships that shrink in payment; provision of information about light dues and technical matters.

Keywords: public goods, analytic narrative, history of public economics

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1. Introduction

The purpose of this paper is to discuss the incentive structure or the mechanism that defines private and public provision of public goods. The hypothesis tested states – can pure public goods be privately provided under a publicly provided institutional system? This institutional system may differ, but it is a combination of property rights, legal order and financial support. Methodologically, analytic narratives are used based on historical studies of the provision of lighthouse services in Estonia. The method enables a theoretical discussion over the boundaries of private initiative in collective goods provision and also a dialogue with Coasean principles.

Starting from Coase (1974), a lighthouse is debated as being or not being a perfect example of public goods which instead of private individual or firm should be provided by the government. Looking at the historic mindset until the Coasian “revolution”, we see that lighthouses are considered to be a perfect example for public provision. In Mill’s *Principles* (1848), the government was mentioned as a builder and maintainer of lighthouses. Furthermore in 1883, Sidgwick stated: “[...] there are some utilities which, from their nature, are practically incapable of being appropriated by those who produce them [...]. It may easily happen that the benefits of a well-placed lighthouse must be largely enjoyed by ships on which no toll could be conveniently imposed” (Sidgwick 1901: 406). Pigou considered the lighthouse a perfect example of a service where “marginal product falls short of marginal social

net product” (Pigou 1938: 183-184), which is an often used concept to relate the public good provision to the broader issue of externalities. The latter also defines the boundaries of private enterprise and agrees that there are “some indispensable public services without which community life would be unthinkable” (*Ibid.*) and thus the role of the government is imminent. Classical writing of Samuelson (1964: 159) states clearly that “[...] a businessman could not build it [lighthouse] for a profit, since he cannot claim a price from each user. This certainly is the kind of activity that the governments would naturally undertake”.

By definition the consumption of public goods is not excludible and nonrivalrous; and the provision is related to nonexistent marginal costs. These arguments are diminishing consumers’ interest in revealing their interest toward such goods and thus the question – is a private enterprise able to provide certain kinds of goods – is more or less the question of ability to charge the consumer. Is charging really impossible? Coase (1974) shows that by the example of the British system all the latter statements must be reconsidered and the “Estonian system” gives similar implications.

The British lighthouse authority – Trinity House – has been, but not always¹, responsible for the provision of seamarks. However Trinity House has been an ancient institution evolved out of a medieval seamen’s guild, and the patent of the right to regulate pilotage was granted to the institution in 1514. In 1566, it acquired the right to control the maintenance of privately held seamarks, and in 1594 to also place marks. Although Trinity House built some new lighthouses, from 1610-1675 ten were built by private individuals, and none by Trinity House. Also, at this time the King gave patents to private bodies granting the right to levy tolls. Tolls were collected at the ports by private individuals or by custom officials. Tolls varied between the ships, dependent on the size of vessels. In the late 17th century, Trinity House adopted a policy of cooperation with private individuals – giving grants for a lease to build and maintain a lighthouse and share profits with Trinity House. In 1820 there were forty six lighthouses: twenty four operated by Trinity House and twenty two by private individuals. Only eleven of them were actually built by Trinity House. Trinity House, because of strong support by Parliament to purchase them, left only fourteen lighthouses to be run by private individuals by 1834. In 1836 an Act of Parliament vested all lighthouses in England to Trinity House, and this was more or less accomplished by 1842. Centralization was justified by the too high light dues.

Leaving the discussion of light dues’ rates open, we note that even a centralized lighthouse service provision has been based on the collection of dues from ship owners. Thus the orthodox argument is overruled – ships were made responsible for their own “consumption” of lighthouses. And the lighthouse services were not financed from general state revenue. For a comparison, let us have a few insights into the Estonian experience of providing such services.

¹ The review of the British system is based on Coase (1974, p. 362-372).

Compared to the British sources, no systematic study of the financing of the building and maintaining of Estonian Lighthouses exists. The memoirs about the history of lighthouses provides us some insights. Luige (1982) states that Estonian lighthouse history started at the second half of the 15th century, when the Hansa league was initiating the building of the Kõpu lighthouse. The Swedes initiated building two more lighthouses in 1646. From this time on, private individuals were maintaining and building lighthouses even after the Uusikaupunki Peace Treaty by which Estonia became part of the Russian Empire. The Swedish-German nobility retained the privileges of owning and charging tolls. Although all new seamarks were initiated by the state primarily for military purposes, the toll or light dues were still collected from ships. Almost all lighthouses and other main seamarks were finally owned by the state in the end of the 18th century. At least seven new lighthouses were built by the central authority and one by a private initiative during the second half of the 19th century, increasing the total amount of lighthouses and marks to approximately fifty. During the first Estonian Republic (1920-1940) a new agency – *Mereasjanduse Peavalitus* – was created, which outsourced building to private firms until 1934 and was still financed from light dues. Starting from 1934, thirteen new lighthouses were built by the state brigade, all financed by the state budget. This system came to an end in 1940 after Soviet occupation.

The preceding review of the Estonian system is far from complete, and a more detailed description of the Estonian system is one of the objectives of the current study. Collected data (mainly archive documents) are used to construct an analytic narrative. This narrative is a combination of a rational choice game, theoretic deductive logic and historical study. Narratives are not used, like historians or anthropologists usually do, for describing ethnical and cultural ideologies building up people's identities, rather *vice versa*. The analytical part of a narrative is coming from the analysis of choice rules and payoffs of the individuals using non-cooperative games. Bates *et al.* (1998: 10) proposes that "...it [analytic narrative] combines analytic tools that are commonly employed in economics and political science with the narrative form, which is more commonly employed in history". What is meant to be a narrative and analytic is explained – "Our approach is narrative; it pays close attention to stories, accounts, and context. It is analytic in that it extracts explicit and formal lines of reasoning, which facilitate both exposition and explanation" (Bates *et al.* 1998: 10). Games are used to make the framework comprehensive, while archive, anthropological and ethnographical sources are mixed to provide information for reliable narrative building.

The paper proceeds as follows. Section II gives an overview of the theoretical discussion over the public-private dilemma. Section III reports on the relevant history. Presenting the history is not a subject on its own. It encompasses the narrative, which is used for building the game theoretic analyses. Section VI presents the "rules of games". These institutional rules may permit or promote private provision. Section V discusses the narrative in the light of a game theoretic model and alternative academic findings. The conclusion is the elaboration of ideas that give historical insights into the current mindset over the boundaries of private-public dilemma, if there is a dilemma at all.

2. Private versus public – discussion of theory

The terminology of public goods was developed in economics by Samuelson (1954) and has been expanded later on by many. Head (1974) enumerates ten different characteristics of public goods: decreasing costs of production; externalities; joint supply; nonexclusion; nonrejectability; benefit spillovers; unenforceability of compensation; indivisibility; nonappropriability and nonrivalness. We can add the free rider possibility (Buchanan 1975: 207) and lumpiness (Head 1974: 168). Many of these characteristics are evidently related to each other and thus reduction to a few crucial ones is possible. According to Ver Eecke (1999), the ideal concept of public goods has only two factors that distinguish those from private goods: (1) they are “joint in supply”, so that consumption by one person does not diminish the amount available to others (also called nonrivalness). (2) They are “nonexclusive” so that if the good is available to one person, it is automatically available to all others. This narrow economic interpretation of public goods helps to define two main problems of the public goods provision. The first problem is that if one person purchases public goods, others will also be able to consume the goods and thus take a “free ride”. That arises the question of the “fair distribution” of costs – who must pay for public goods? The second problem is the optimal or at least suboptimal provision of the good. The possibility to free ride gives consumers an incentive not to reveal their preferences for the goods and hope that others will meet the costs of their provision. This result lowers the level of production less than optimal from a societal standpoint. Pigou (1932) states that this constitutes an externality problem – marginal revenue and social marginal benefit is much higher than the marginal cost of production.

If our aim is to assess the possibility of private agents to provide public goods, then both factors need clarification. First, “jointness of supply” technically means that each of the next customers will not create any additional costs to the provider, thus marginal costs of extension (MC_e) are zero. This doesn't mean that the second type of costs – marginal costs of production (MC_p) – are zero as well. But public goods are not free goods, and MC_p can be positive and decreasing. In the case of lighthouses, we have high fixed costs but also nonexistent MC_p . Thus a lighthouse is a perfect example of good that satisfies the first necessary condition from the definition of public goods.

Second, it is important to understand that “nonexclusiveness” is not the same as the producers' inability to control exclusion (Snidal 1979: 541). If producers cannot control exclusion, the marginal cost of exclusion (MC_{ex}) is infinitely big. The level of MC_{ex} will depend on many aspects, but most of all the physical properties of the good and the social context of the consumption. The latter is a combination of social structure, government power and property rights. It is clear that the physical conditions of the lighthouse do not make exclusion a low cost activity. However, the social context – protection of the property rights facilitated by a strong powerful central force and enforcement of laws can lower the MC_{ex} . Thus even in such goods where physical properties will not make exclusion easy, it may be possible to exclude “free riders”.

Conclusively the ideal type of public goods is defined by $MC_e=0$, $MC_p=0$ and $MC_{ex}=\infty$. Snidal (1979) states that if

$$MC_{ex} > MC_p, \quad (2.1)$$

then no private attempt will be made to exert exclusion over the goods, since control over exclusion is more costly than the provision of the units themselves. Therefore all production in this range will be in terms of public provision. Theoretically, in the case of lighthouses, private provision is possible only when social context will totally take over the control of consumption, meaning that for a private producers $MC_{ex} = 0$. Thus the notion of control over the exclusion is the fundamental question and the existence of an authority system to enforce price exclusion is a vital question.

However the question remains – is the public control over price also enough to ensure economic efficiency in private provision of public goods? It is clear that any restriction on the distribution of the goods having jointness in supply that serves to restrict the extent of distribution of already produced units of those goods is suboptimal. Whenever $MC_{ex} = 0$, then, if there exists any potential consumer who has positive marginal benefit from the good, optimality requires that the good be extended to them. Thus the ideal price system from the efficiency perspective would be a system of perfectly discriminating monopolist who has perfect knowledge of the preference functions of all shippers. This system will grant Pareto efficiency and private provision of the lighthouses at the same time. How difficult is it to collect information about these preference functions? Generally speaking not too easy, but we may use proxies because in ports there it is quite easy to acquire information on particular vessels, such as length, draft, gross tonnage, cargo, owner, etc. It should therefore be straightforward in terms of levying a charge on any such a ship entering a port (Baird 2004: 378). Those who refuse to pay such charges would be subject to legal proceedings brought against them.

Of course we may state that the Snidal condition ($MC_{ex} > MC_p$) does not pay any role to a public benefits created by the seamarcs, ports and lighthouses in general. Public benefits such as the development of marital trade as a part of the creation of economic welfare, or public military interest related to territorial claims or mercantilist public benefits from greater territory, have not been included in the analyses. The “standard efficiency condition” related to large-number case is set by

Samuelson (1954) that $\sum_{i=1}^n MRS_i = MRT$, where MRS_i is i 's individual marginal

rate of substitution between the public goods and arbitrarily chosen private goods and MRT is marginal rate of transformation between the same goods. MRS can be interpreted as the disposable income the economy is ready to sacrifice for an additional unit of public goods (Bergstrom *et al.* 1988). In large n situations “welfare calculus”, like “Samuelson efficiency condition” demands, has a marginal analytic value, because of the subjective and dynamic nature of vital information. *Ex ante* predictions are hard or impossible to make.

However in some circumstances lighthouses could provide this additional utility to only certain restricted groups, such as local seamen or local village in general. Thus in some circumstances lighthouses can rather be club goods, which are excludable with congestion (Buchanan 1965). Buchanan (1975) suggests that in small groups organization and enforcement of efficient institutional arrangements for provision of such goods is possible, but rarely successful under a large n . Wicksell's unanimity rule (Buchanan 1975) also supports the argument that the free-rider motivation can be eliminated only when an individual is made aware that their own choice among alternatives does affect, and in some positive and measurable sense, the outcomes of others in the group, even if the membership is large. This of course leads us to the game theoretic definition of the public good dilemma.

To illustrate the need for institutions, Taylor (1976) established public-goods problems as prisoner's dilemma (PD) game where agents can state true preferences or lie about their rates of marginal substitution between public goods and an all purpose private goods. Taylor (1976) showed that if no binding contracts can be enforced between the agents, a nonoptimal equilibrium will result in which the public good would be underprovided. If there is no planner who has information about the preferences of the agents, then it is difficult to imagine that planner can organize the economy efficiently. Although, as is the case for Shubik (1973) and Hurwicz (1973), social institutions can have various rules of conduct that are defined by the planner and whose definition determines different n -person games. This kind of institutional scholarship suggests that planners devising optimal allocating mechanisms will make agents reach towards an optimal equilibrium (Schotter 1981). This will lead us again to the idea, that for the private provision at least some kind of institutional mechanism is needed; either for (1) lowering or ceasing the costs of exclusion; or for (2) changing the game structure so that private agents have incentives to reach to the optimal allocation in PD framework.

3. Narrative: The Estonian system

Chronologically we can divide the Estonian lighthouse system into four periods: (1) The Swedish and Hansa period of foundation (from the first half of the 16th century till the end of the 17th century); (2) Private property under the Russian Empire (18th century); (3) Nationalization (19th century till the Estonian Republic in 1920); (4) State and private partnership (1920-1940). The division is initiated from an institutional ownership framework and has only analytic purposes. In all periods we are interested in special features of the system – ownership; who is the provider of service; financing (also administration of it); and initiation of the construction. The change in the general state structure can also initiate the quick alteration of the ownership structure, however the change may also be gradual; vested interest of agents and institutional setup can make quick changes impossible, thus presented chronology will not perfectly reflect change of political regimes.

3.1. Foundation

The earliest evidence of the first light-marks reaches us from the first part of 16th century. The ownership form of those is not that easily definable – most probably it was some kind of mixture of private and public.

In 1697 *Placat* announces Swedish rules defining punishments to local communities who damage drifted ships and sailors, showing that social evolutionary institutions – consuetude was not self-enforcing. However according to Spafarjev (1820: 10) there existed the so-called ancient *Stranda*, that was an informal institutional rule; according to which “rescue teams” (who were either owners of the private light-marks or local community members) received a part of the rescued cargo. The first indicates the public interest in marital affairs and the second the existence of the “global” informal rules. The economic development as an indicator of naval activity is probably vital here, because initiators of the building of the Kõpu lighthouse in 1531 was Hansa or more concretely the Revals Magistrate, and this encounters a flourishing era for the Hansa League. Kreem (2008) assures that in the case of Kõpu most of the finances came directly from Revals Magistrate, but if they were part of the taxes from the general city revenue is not known, although it is known that buoys mounted near Reval were financed by a separately levied tax. After the building of Kõpu the economic slowdown, that endured approximately a hundred years, started (Küng 2004: 19). This is probably why there is no information about the operation of the lighthouse, and it may even be doubted if the light-mark was operational until 17 century (Luige 1982: 15).

Later the Swedish state became the initiator of building other sea-marks. Relying on Küng (2004: 21) we may argue that Hansa and other private merchandise became a state interest – competing with the threat of the Netherlands sea-monopoly; interest in increasing tariff revenues; and interest in creating a fleet and navy. Offering tariff abatements for Swedish ships was reactivating navigation and in 1646 building of the wooden lighthouses in Sõrve and Ruhnu was initiated. Permission to build lighthouses was given to local land owners and this regulation was in force till the 19th century and in the interest of local navigation probably also later. However, (as far as we know) in this period the initiators were Hansa, the City Magistrate or Swedish state; and local nobility only built-maintained and also received financing for their effort. As a matter of fact the cost of building and maintaining was high and was assigned to local peasants-bondservants for “optimization” purposes. Costs were financed by collecting light dues from local ports. Luige (1984) assures that all cargoes landing in Riga, Pärnu or Kuressaare were taxed, light dues were four state thalers² per ship.

A new economic boost in the Baltic Sea took place at the end of the 17th century, with the number of vessels under the “Estonian towns” flags increased almost tenfold (Küng 2004: 25). During the same era the cargo fleet of Estonian and Livland towns was founded (Küng 2004: 27). However, May (1936: 87) confines

² According to Vanamõlder (2007) this was approximately the price of 25 kg of wheat.

that in the year 1750, Estonia had only six lighthouses: Kõpu, Keri, Suurupi, Pakri, Sõrve and Ruhnu. The building of three of them – Keri, Suurupi and Pakri – can be enrolled to the “good old Swedish times”. Keri or Kokskäri was ready in 1721, Suurupi was not fully ready until 1760, and the exact foundation date of Pakri is not known, but it was ready before Peter the Great died in 1725.

3.2. Private property under the Russian Empire

The 18th century is a new period in ownership-relations. All seamarks under the Russian Empire were officially subordinated to the Tsar State Admiralty, who became a new initiator of building new lighthouses. According to the 1721 Uusikaupungi Peace Treaty Kõpu, Ruhnu, Kolka (Domesnäsi situated in current territory of Latvia) and Vaindloo (Stenskäri or Seiskäri was built by 1718) went under Russian supervision. At the same time, all of the aforementioned lighthouses, excluding Vaindloo, still remained under the well known Swedish-Baltic nobility, Osmussaare (built in 1765) was finally given to the state only at the beginning of the 19th century (Luige 1984: 28) and Kõpu even later. The institutional structure probably remained unchanged as a part of concessions the state made to the local nobility for their support (Laur 2000: 31). Till the 18th century there was no major change in this so called Baltic special-order and only laws, which were not antagonistic to the local confirmed privileges, were applicable in the Baltic territory (Laur 2000: 203). According to privileges, half of the light dues collected from cargos were distributed to the owners (Luige 1984). Light dues were probably collected in custom offices which according to Laur (2000: 60) were located in Pärnu, Kuressaare, Tallinn, Haapsalu and Toolse.

The customs-officials were not subordinates of the provincial government; and whereas the importance of tolls among state revenues was substantial, the size of the bureaucracy of customs was remarkable. Although in all other state-institutions the working language was still German, in customs it was Russian (Laur 2000: 62). At least some orders were taken directly from the “central government”, for example in 1723, the decree of Peter the Great ordered that in dark nights the lights must be ignited only when their “own” ships were on the sea (Luige 1967: 27). Economic policy preferred Petersburg’s port to Riga and Tallinn, also custom tariffs and bans on grain export diminished the amount of cargo remarkably (Laur 2000: 173-176). Probably existing lighthouses still operated. And privately run lighthouses were still operated – equipped with wood and lights maintained – as a natural burden by local serfs (Aitsam 1937: 26). For meeting operation costs, owners received direct allowances from the state and/or according to the contracts still half of the light dues were distributed to owners. Aitsam (1937: 27) states that in the case of Kõpu, there was a contract, according to which 3000 roubles were paid annually for the maintenance of the lighthouse. Predictably the contract was due even until 1910. In addition all kinds of renovation expenditures were met separately (*Ibid.*).

During the second part of the 18th century only one more lighthouse was privately built – Osmussaare (May 1936: 87). The first twenty years of the 19th century gave a boost to public lighthouse building

3.3. Nationalization in the 19th Century

The reign of Catherine II also brought changes to the so called Baltic special-order, which had been tolerated for a half of a century. Attitudinal change resulting from the legal change in Baltic affairs also gave ground to alterations in lighthouse legislation. “Global” ideological change probably also played a role: in Britain, an ideological change against private profit earning was emerging (Taylor 2001: 750). There were also some bureaucratic changes as Leonti Spafarjev was appointed as the Head of Lighthouse Supervision and stayed in the position for 35 years (Luige 1984: 38). Spafarjev called for many changes and reorganizations. All publicly owned sea-marks located in Estonian territory were divided into two expeditions of Kronstad and Tallinn. The rest of the lighthouses (e.g. Kõpu, Ruhnu and Osmussaare) were probably privately run. Spafarjev stated that lighthouses in private hands were unsafe, had obsolete technology and hindered safe navigation (Spafarjev 1820: 10). In addition, he condemned the ancient *Stranda*, which delegated part of the cargo to the saviours: “This rule can be efficient only accompanied by affection to fellow man and sense of righteousness, which must dominate over greed” (Spafarjev 1820: 9). The military aims must also not be underrated, as there were accusations that the light-ship crews are not sufficiently state-minded (Dampf 1935). In 1805, Spafarjev was ordered to compile data for budgeting the building of new lighthouses. According to Luige (1967: 28) Admiralty-department decided among other things also transfer Kõpu from private hands to public ownership. The grand plan of Spafarjev’s was almost completely implemented. During the first twenty years of 19th century, 13 public lighthouses were built, the majority of Finnish and Riga Gulf lighthouses were renovated, and also two light-ships were manned.

In 1807, the majority of lighthouses went to public hands (Mey 1936: 86), but private lighthouse ownership did not disappear completely. Mey (*Ibid.*) states that two Kolka lighthouses, which according to the old Swedish privileges from 1608 belonged to Duke Osten-Saksen, remained the owner’s. Aitsam states (1937: 27) that Kõpu also stayed in private hands and its owner Duke Unger-Sternberg possessed also two additional lighthouses - Paralepa and Hobulaiu (Tallinna Kinnistusamet 1939). There were probably some other local sea-marks or lighthouses, that have been noted in Duke Nolcken’s correspondence (Nolcken 1923; Nolcken 1926) about the Postrova lighthouse in the Alatskivi manor (at the shore of lake Peipsi).

At the end of the 19th century, there were about fifty lighthouses and sea-marks. By then, new technology of metal construction prevailed. The first concrete lighthouse was constructed at Viirelaid (Paternoster) in 1857, followed by new lighthouses of Keri (1858), Vormsi (1864), Kihnu (1865), Virtsu (1866), Vaindloo (1871) and Tahkuna (1875). All aforementioned were public premises. There is data about building at least two private lighthouses during this period – in 1840, Ungern-Sternberg built a lighthouse and a keepers-house (later a pub as well) in Harilaid. One wooden lighthouse in Käsnu (1891) was initiated by the local community, financed from fines collected from drunk captains (Luige 1982: 49).

3.4. State ownership during the Estonian Republic

The Estonian Republic placed the Department of Waterways (under Transport Ministry) in charge of the maintenance of lighthouses. All private lighthouses belonging to the local Baltic nobility were nationalized together with accompanying manor lands. After nationalization and reallocation of the manor lands, some sea-marks remained on the privatized lands. These lighthouses (Paralepa and Hobulaiu) were separated from the farms and compensated by the state (Tallinna Kinnistusamet 1939). Renationalization of land under sea-marks lasted until 1939 (Riigikantslei toimik 1939, 1940).

According to payrolls from 1920, the Lighthouse Department had thirty four lighthouses in addition to pilot and rescue-ports. The Lighthouse Department became a contractor to private firms, technical supervision remained the responsibility of the Department of Waterways. In 1934, instead of continuing a private-public partnership, a state brigade started to build and renovate lighthouses. During the following eight years, this brigade built twenty five reinforced concrete lighthouses (Luige 1982: 72).

The revenues of the Department of Waterways came from port dues. According to *Riigiteataja* (1924), differentiated port dues were collected from foreign and domestic vessels, as well as from sailing, steam or motor ships. Port dues consisted of pilotage, lighthouse and cargo fees; also dues for lifesaving, for sailors' retirement homes, for social security, for ice-breaking, for fresh water, and for winterization. Light dues were only paid in the first port in the territory of Estonia and were not dependent on the number of visits to other ports. Light dues were dependent on pilotage, and domestic vessels paid annually for eight voyages, foreign-going vessels for four voyages. Depending on the aforementioned criteria, light dues stayed in between 0.24 to 0.3 golden francs³ for each net registered ton of cargo. In 1924 port tariffs changed only marginally the arrangements that had been set in 1921 (*Riigiteataja* 1921).

Although all lighthouses belonged to the state, some private ports remained: Kunda, Tallinn-Beckeri, Tallinn-Balti Shipyard and Kärđla port. State covered costs related to sea-marks also in private ports (Kõpu 1930). All lighthouse servants were on the state payroll, and had long term contracts. In 1930, there was a political initiative to transfer fourteen "strategic" lighthouses under the supervision of the Defence Ministry and substitute life-time servants with soldiers, but this proposal didn't find support in the Senate (*Riigikogu kantslei* 1930). In state ports, pilots were also on the state payroll, but private pilots in Harilaid and Kärđla were probably also self-employed, because they can not be found on the state payrolls (Kõpu 1930).

On 15th May 1940, the Soviet Military Commandatory announced to the Estonian Government that according to the Molotov-Ribbentrop pact they would take over the following lighthouses: Pakri, Osmussaare, Tahkuna, Ristna, Kõpu and Sõrve

³ This is approximately the price of ½ kg of butter.

(Sõjamineeriumi toimik 1940). In addition, a few months later, a telegram was sent letting the Government know that the Soviets have the intention to also take over the lighthouses in Suurupi, Naisaare, Keri and Juminda. Later many other lighthouses were also handed over.

The Department of Waterways was liquidated on the 1st January 1941, and all its responsibilities, excluding military holdings in the above-mentioned lighthouses, went to the newly created agency of *Merelaevandus* (Luige 1967: 35). At that time, there were 140 different sea-marks for navigation purposes in Estonian waters: 117 lighthouses, 20 light-buoys and 3 light-ships (Luige 1967: 36).

4. The Lighthouse Game

Non-cooperative game theory is typically used to explain the prisoner's dilemma characteristics in the public goods' dilemma (Schotter 1981). The illustration of a free-rider problem in a 2×2 matrices indicates that the players' optimal strategy is to hinder information about their true preferences in public goods. Non-cooperative games are also used in experiments, where different aspects of the dilemma are studied. Dawes (1980) showed the role of small groups; Maxwell and Ames (1980) and Axelrod (1984) indicated the vital role of repeated action; Schwartz-Shea and Simmons (1993) presented the importance of framing; and Turner (1981), Kramer and Brewer (1984) introduced the role of group identities. In experimental games the PD is typically presented via return function – choices of the individuals are contributions to the cost and payoff functions depends on the total contributions of the players (Goetze 1944: 66). Experiments also indicate that the credible threat of punishing will solve the under-contribution problem in the public goods games (Noussair, Tucker 2005; Bochet *et al.* 2006). However there are not many empirical papers, besides experimental ones, which rely on non-cooperative games. Bates *et al.* (1998) starts almost a methodological innovation in this area. One of the proposals of this methodological “new wave” is to use structural solutions in explaining empirical phenomena. Structural solutions change the rules of the game through modifying the social dilemma (Swedberg 2001). Altering payoff profiles, affecting available strategies or including players – all these belong to the toolbox of structural solutions. The current model follows the “new wave”.

Our lighthouse game, as a public-good provision game, is a PD where two players, “private owner of the lighthouse” (*lighthouse*) and “ship owner” (*ship*), both have two options. The *Lighthouse* can provide either credible or non-credible service, and the *ship* may pay light dues in the nearest port or evade the due. The credibility of the lighthouse has been an empirical problem mentioned in all eras of our narrative and is considered one of the main reasons for public interference by Spafarjev (1820). Also commonly told stories about shore-robberies and false lighthouses were common even continuing up to the present, supported by Otzen-Hansen (1884) and Aitsam (1937). The *Ship* has the classical choices of a free-rider – to pay or not to pay. Payoff profiles indicate possible interdependent mutual payoffs related to the benefits from service and related costs of providing goods or paying for it. In figure

1: b_1 are the *lighthouse* benefits paid by the *ship*; $c(t)$ indicates the costs of providing credible service, where t stands for technology; C is the fixed costs of providing “false lights” and b_2 are benefits to the *ship*.

In such a game both players have a dominant “action” and the game has a Nash equilibrium in payoff profile $(-C; 0)$, indicating that the *Lighthouse* will provide non-credible service and the *Ship* will not pay. Of course this classical Prisoner’s dilemma result is not Pareto efficient. Both parties are kind of trapped into bad outcomes, instead of credible service and payment they both optimize and lose. A normal form game assumes that players act simultaneously, but even if we add a time element to the game, and assume that payment is made after the credibility is checked, we end up with the same result. Technically speaking – the prisoner’s dilemma will not allow an easy solution by making games extensive. A time element can allow a ship to assess the credibility of a *lighthouse* service in the first stage and hence the *ship* can make the payment decision in the next port. Unfortunately the time element will not get us out of bad outcomes. However the normal form or extended form setup of the game demands that players have one-time interactions only. In repetitive setup, where interactions are frequent, all kinds of strategic outcomes are possible. Axelrod’s (1984) optimistic standpoint about the human ability to cooperate in repetitive games is well known. However, in our case a close face to face interaction is not taking place and the credibility of such reputational or strategic solutions is questionable.

		<i>Ship</i>	
		Pay	Not pay
<i>Lighthouse</i>	Credible	$b_1 - c(t); b_2 - b_1$	$-c(t); b_2$
	Not credible	$b_1 - C; -b_1$	$-C; 0$

Figure 1. The lighthouse game.

Structural solutions involve, for example, a change of rules of the game by changing rewards or punishments related to the game which allow players to change their behaviour toward more cooperation or by changing the structure of the game directly by adding or subtracting the players (Rittberger 2003). This “third party” can be either some social norm, which will affect payoff profiles of the players, or more formalised institutional body, e.g. government or some other body that can protect property rights and enforce contracts (Van Vugt 1998). This “third body”, which will simply be called the *institution*, can implicitly affect the structure of the game directly or through payoffs, in both cases *ex post* payoffs will be affected. Also we assume first that the institution itself has no preference order, although the latter in the case of an institution widely defined – institution as an organisation – we make the institution explicit. In the first step we add a narrowly defined institution according to North (1990) – institutions are the rules of the games – which have no

preference order of their own. Thus we can still use the 2x2 normal form game structure (see Figure 2).

		<i>Ship</i>	
		Pay	Not pay
<i>Lighthouse</i>	Credible	$b_1 - c(t) + r; b_2 - b_1$	$-c(t) + r; b_2 - p$
	Not credible	$b_1 - C; -b_1$	$-C; -p$

Figure 2. The lighthouse game with rewards and punishments.

In Figure 2 we add punishment and rewards to the *lighthouse game*. Let us assume that a credible provision of the lighthouse service will be rewarded by some fixed amount r and not paying by threat of legal punishments (or community punishments) is indicated by p . If $r > c(t) - C$, where r is some type of reward for a provision of the good, then a non-credible provision will be the dominated action, but it makes “not pay” a rational temptation. Thus we need another instrument to make payment credible. If $p > b_1$, where p is some sort of punishment for not paying, then such a game has a self-enforcing property – players will reach to the Pareto efficient outcome and the properties of the prisoner’s dilemma are lost. From the *state* perspective, the game has a weakly dominated Pareto efficient equilibrium when:

$$\begin{aligned} r &\geq c(t) - C \\ p &\geq b_1 \end{aligned} \quad , \quad (4.1)$$

indicating that *the state* has to provide the private body a reward, which is at least as big as the difference in the costs of operating a credible service. Assuming that C indicates fixed costs of building and $c(t)$ indicates the total costs, then the reward must be at least equal to the variable costs of providing the lighthouse service (although these variable costs are not affected by quantity of ships consuming the service and still $MC=0$), plus the costs of extension. In the late medieval and early modern age, where technology (t) gives local landlords comparative advantage in running the operation of the lighthouse compared to some central (merchant or city) institution, it is imminent that expected rewards could have been relatively lower. Technological change affects the optimal combination of capital and labour, so that more technology specific capital and labour was needed for building a lighthouse – first in the late 19th century with the Gordon system and later in the early 20th century when reinforced-concrete was used. This gave a comparative advantage to specialised units for constructing a lighthouse. So the private costs for building a lighthouse went up despite $dC(t)/dt < 0$.

If the conditions (4.1) are satisfied, then the punishment (p) is just a credible threat and that is why we are not able to indicate any narratives related to punishing the ships that didn’t pay light dues. Although payment $b_1 \leq b_2$, indicate that if ships

have “subjective” preferences and benefits from the service, then payment must also be discriminating among them.

Now we take one step further and make the preferences of the state explicit. We assume that *the state* has certain military or trade growth related preferences to control the provision of the lighthouse service – assuming that the state has clear preferences that a certain efficient amount of lighthouse services have to be provided. This can be accomplished through private or public provision. In the first stage of the game *the state* just observes the choices of *the lighthouse*, who can either provide an efficient (E) or not efficient (NE) amount of service. In the second stage of the game *the state* can, in the case of NE, provide goods on its own or create institutional support for efficient private provision. In the third stage *the lighthouse* makes again its choice over efficiency of provision and then the game is over (Figure 3).

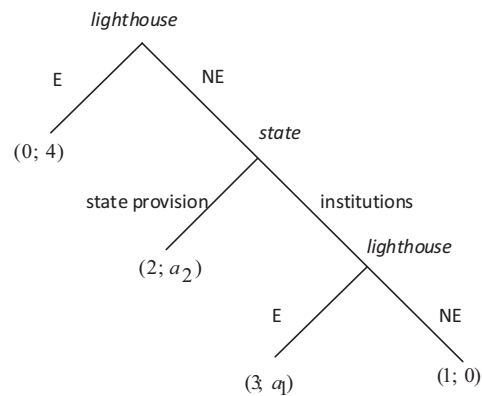


Figure 3. *The state and lighthouse game.*

Payoff profiles in the state and lighthouse game indicate cardinal utility coefficients. In the first stage *the lighthouse* has a certain incentive to choose NE and in the last stage *the lighthouse* will choose E. Thus the subgame perfect Nash equilibrium will depend on the relationship between a_1 and a_2 . If $a_1 > a_2$, then *the state* will provide the institutional framework described in the “lighthouse game” in Figure 2, and the game will end up in the third stage by $(3, a_1)$. But if $a_2 > a_1$, then *the state* prefers to provide public lighthouse services and the game ends in the second stage. The ideological change – the alternation of the importance of military power, trade dominance or other chauvinistic attitudes of the state – will also affect the preference ordering over a_1 and a_2 , and thus affect *the state* strategies. Although it is worth mentioning that *the state* has no dominant strategy in this game and *the lighthouse* has a weakly dominant strategy NEE, which makes NE the optimal choice in the first stage and E in the last stage, independently from other player choices.

5. Back to the narrative – Discussion

Summing up the results of the previous section, we may say that the private provision of lighthouse services is possible only when there is some institutional frame to support private activity. This institutional support must have two components – a credible threat to punish shirking ships and a reward system for private providers to lower the costs of provision. The latter is consistent to the Snidal condition (2.1). The extensive form game (Figure 3) indicated that if the state has their own preferences over possible outcomes it may not provide institutions for efficient operation of private sector, but rather provide lighthouse services publicly. Now we turn back to the narrative to confirm that theoretical founding can be verified.

Our four-period description of the Estonian lighthouse system shows that lighthouses were never purely publicly provided nor purely privately provided. In Figure 4 we are using the structure of Van Zandt (1991) poles, where the public-private dilemma is not a dichotomy, but divided into certain poles: (1) private provision with no government enforcement; (2) private provision with government enforcement of property and contract rights only; (3) private provision with government fixing rights, granting monopolies and enforcing collection of specified user levies; (4) government provision from collection of specified user levies; and (5) government provision from general revenues.

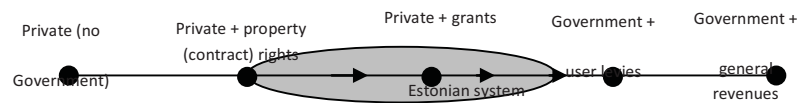


Figure 4. Estonian system and Van Zandt (1991) poles.

We see that historically the Estonian system has moved step-by-step from a private provision with a central collection of grants and some state initiative over allocation of public goods to a public provision. At the same time the system never reached the extreme – lighthouses were not financed from general revenues. At the same time the government played a substantially greater role in the provision of lighthouse services than Coase’s term “private” suggests, the same is shown by Van Zandt (1992: 48). Of course we may argue that almost every market needs some kind of institutional support and in this regard enforcement of property rights may not be a substantial government involvement, and this is not worth mentioning in the lights of Nozick’s (1974) minimal state definition. Of course Nozick (1974) and others (Ellikson 1991; Umbeck1981; Van Zandt 1991) show that the private provision of property rights is possible and is a historical fact, but in our case we see that the government has played a certain kind of regulatory or initiative taking role in every period – declaration and collection of lighthouse dues.

The theoretical model gives the explanations why the system moved towards a more public provision – this was due to technological change and “public” interests. “Public” interests were military and naval ambitions of the Russian Empire which emerged during Peter the Great and also had some element of distrust to the Baltic nobility. These features weakened after Peter’s death and re-emerged during Catherine the Great’s reign. During the Estonian Republic the cost argument due to technological change to the Gordon system and later to the reinforced concrete constructions, justifies the change. The public ownership during this period was mainly the result of historical consequences – nationalisation of all land holdings of Baltic nobility.

Comparing the stake and structure of public institutions in lighthouse affairs (figure 5) we see that periods have differed. We subtract five characteristics of the provision process – (1) who made the decision over building the lighthouse (initiative); (2) who was the legal owner of the asset (ownership); (3) who collected and declared levies (collection of levies); was the production financed by actual consumers or from general revenues (user levies); and who operated the lighthouse (operation). In the figure the origin of axes (zero) stands for private provision and the end of axes (one) for public provision.

Period I is a foundation period (described in section 3.1); period II is a period of private property under Russian Empire (described in section 3.2); period III is a nationalisation period in the 19th century (described in section 3.3); and IV period is a state ownership period during the Estonian Republic (described in section 3.4). In period I there are two characteristics provided by the state – initiative and collection of lighthouse dues levied from the ship. In period II there is already some state ownership and only private initiative taking. In period II most of the initiative, approximately half of the operation and ownership, was public. In the last period only user levies were still paid by private consumers. So periods differed by the institutional framework provided by the state. Only the collection of lighthouse dues by custom officials in the ports was common to all periods. So the cost of exclusion for private providers was zero in all periods, which is also consistent to the Snidal (2.1) condition. In period I the foundation of an impersonal “lighthouse market” was mediated by the Hansa league or the city council of Reval, the city which mainly benefitted from eastern Hansa trade. Also the initiative over questions, such as where to build and how to operate, were in central hands.

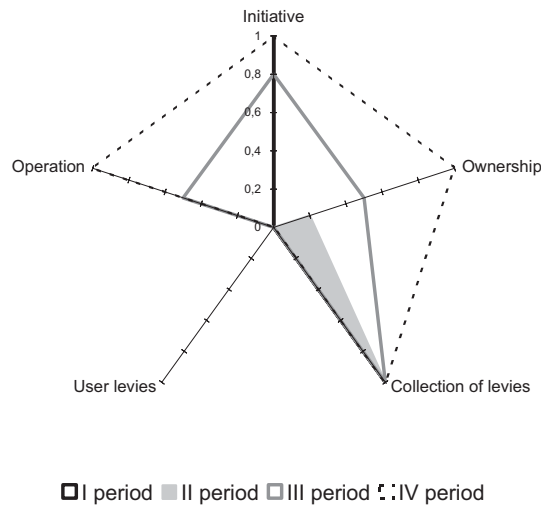


Figure 5. Five characteristics of the institution (0-private; 1-public).

Basically the central body only contracted out building and operation by offering light dues or a proportion of it. During the early “Russian days” in Estonian territory the persistence of the previous system lasted, although Peter the Great recognised the military importance of lighthouses, but he died in 1725 being able to govern the territory for only 4 years after the peace treaty. Instability of the state erased private and state initiatives of building new lighthouses. Only at the beginning of the 19th century did the state take the initiative of organising lighthouse affairs, this also brought along many new lighthouses and an attempt to take over some private ones. However the legal system protected the property rights of the local nobility and despite of the preferences the state was not able to take control of all the lighthouses. Still some private lighthouses were built on private land. The Estonian Republic nationalised the lighthouses and the state also provided the service, although there was some private contracting in building lighthouses in the early days of the republic. Also it is interesting to draw attention to the system of lighthouse levies – price discrimination between domestic and local vessels, by tonnage and by type and power of engine. Assumable this kind of pricing has historical roots and this indicates that a private system might have been efficient. We see that historically the Estonian system has gradually moved from a private provision with a central collection of grants and some state initiative over allocation of public goods to a public provision. The system never reached the extreme – lighthouses were not financed from general revenues. However, the state played a substantially greater role in the provision of lighthouse services than Coase’s term “private” suggests. The same is shown by Van Zandt (1992: 48). Of course we may argue that almost every market needs some kind of institutional support and in this regard enforcement

of property rights may not be a substantial government involvement. Nozick (1974) and others (Ellikson 1991; Umbeck 1981; Van Zandt 1991) show that the private provision of property rights is possible and is a historical fact, but in our case we see that the state did more. It has played a certain kind of regulatory or initiative taking role in every period, this was declaration and collection of lighthouse dues.

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Comparing the stake and structure of public institutions in lighthouse affairs (Figure 5), we see that periods have differed. We subtract five characteristics of the provision process – (1) who made the decision over building the lighthouse (initiative); (2) who was the legal owner of the asset (ownership); (3) who collected and declared levies (collection of levies); (4) who was the production financed by actual consumers or from general revenues (user levies); and (5) who operated the lighthouse (operation). In the figure the origin of axes (zero) stands for private provision and the end of axes (one) for public provision.

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6. Conclusions

Until recently many policy-makers argued that “public goods” must be provided by the government if they are to be provided at all. A revisionist Coase (1974) article showed that lighthouse services were, in fact, provided by private enterprise for an extensive period of human history. This public-private dilemma is our main interest and we seek for the analytical narrative to present a mechanism which will allow public goods to be provided privately.

The typical features of public goods that make them market failures are: “jointness of supply” or nonrivalry and non-excludability. The first feature creates a problem of free-riding and the second that private owners have technical or legal difficulties of controlling exclusion. The first problem is related to pricing – make “consumers” responsible, or simply – how to make ships pay, because any free-riding will make the quantity provided suboptimal. This also raises the question of technological improvement and innovations, which are considered to be an imminent side-effect of the competitive market. The second problem – control over exclusion – is not supported by natural characteristics of the lighthouse. But this does not mean that control can not be executed. For the private agent it can be related to high cost, but for the powerful agent like government the execution of property rights and management of pricing system can be much lower in cost, if it already has a supporting institutional structure – custom officials in ports, legal and other power structures for protection of property rights.

However the definition of “public goods” does not require *a priori* government involvement. And this is shown in the British examples by some authors (Coase 1974; Taylor 2001) and in the current Estonia’s historic case as well. Until 1836 many of England’s lighthouses were privately owned (Taylor 2001: 749) and the same applies to Estonia until the 20th century. At the same time we may say the government played a substantially greater role in the provision of lighthouse services than Coase’s term “private” may-be suggests. Our Estonian system shows

that some government institutional involvement was present in all the different historical periods, the same has also been shown by Van Zandt (1992).

Our lighthouse game showed that the private provision of the credible lighthouse service is problematic. Probably the same *rationell* also inspired fiction by the telling of false lighthouses stories of Hiiumaa (Otzen-Hansen 1884), which as stories told attracted ships to the reefs. The prisoner's dilemma type of game has devastating results – no credible service can be provided. Game theoretic analysis suggests that private provision is possible only when there is a certain institutional framework – rewards to private agents and credible threats of punishments to the ships. Thus there may-be some agreement with Snidal (1979: 550), that even when there is no control over the exclusion of the good itself a central agency capable of charging consumers for provision of the good, can lead to a more optimal provision of public goods. Is the government ready to provide this institutional framework for private agents is a different question. It can be shown that government preferences can make them provide lighthouses publicly.

The narrative shows that according to Van Zandt (1992) we may say that the Estonian case shows, that instead of private and public dichotomy, there is a continuum between poles of pure private provision to full government provision. The latter, in extreme, can be financed from general revenues, which has not been the case in Estonia, at least not till the occupation by the Soviets. Our historic case, from period to period, slipped from private provision with government enforcement of property and contract rights, only during Hansa times, to government provision, accompanied with collection of specified user levies, during the Estonian Republic. In between there was some kind of mixing that allowed private and public provision simultaneously.

The question what kind of “pole” society, where government has no ideological preferences, chooses dependent on two factors – technological conditions and institutional path-dependent framework. First, let us concentrate on technology. Technology defines the efficient combination of manpower and capital needed for construction and operation of the lighthouse. It is clear that the local nobility had cheaper management and labour costs back in history. Of course this advantage was diminishing in time because new technology needed more information and asset-specific labour skills. Also Luige (1982: 73) assures that the specialized state brigade was 40% more cost effective than private sub-contractors in building reinforced concrete lighthouses. Private provision is thus possible only when costs of providing lighthouse services are relatively low and, as the model shows, state “reward” finances, at least exclusion costs of provision, the service.

The second important factor is the historic path-dependent institutional arrangement that can either support or restrict the private provision. This institution can be either formal or informal. Informal arrangements that help organize navigation have a long evolutionary path and can be summarized nowadays in “seaman ethics” and marital law. But even more important is that governments have provided certain services of the lighthouse owners, for instance burning regulations; setting and enforcing a fixed

schedule of light dues and assisting in collecting these dues. This kind of “rewards” decreased the cost of private provision and made it possible after all. Thus we may also say that private operators have provided a cheaper technology in provision of the service and government in provision of tax collection and other institutional setting. In the previously discussed model this kind of reward can take different forms – help in collecting light dues; punishment of the ships that shrink in payment; provision of information about light dues and other important matters as what kind of light is burning and at what time, but also more direct help like financing of the building.

It is also important to state that besides a reward system some kind of punishing mechanism for ship owners is also needed. Our historic case was not able to indicate any punishing instruments and as a model proposes a punishment institution as a credible threat, that makes ship-owners to pay light dues.

The Estonian lighthouse system ensures that the debate private *versus* public provision is not a black and white institutional choice; rather there is a kind of mixed system in which the government provides specific services that can help or restrict the private provision of lighthouses. Thus any type of narratives from history or any others are complementing the theoretical principles for explaining institutional choices needed for the private supply of public or semi-public goods. We hope that the current paper will encourage interdisciplinary research and make analytical narratives a tempting methodology in social sciences.

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TULETORNID EESTIS: „AVALIKE KAUPADE“ PAKKUMISE MEHCHANISM

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Käesoleva artikkel kuulub avaliku sektori ökonomika valdkonda, kitsamalt käsitletakse mehhanisme, mis võimaldaksid erapakkujal toota avalikke kaupu. Hüpotees, mida kontrollitakse, on järgmine – kas erainitsiatiiv suudab luua efektiivsel määral avalikke kaupu? Ning kui hüpotees ei leia kinnitust, siis milline peaks olema mehhanism või institutsionaalne maatriks, mis seda tagaks? Mehhanismi või institutsionaalne maatriksi all peetakse silmas riigipoolset „abi“ turgudele ehk kombinatsiooni omandiõiguse kaitsest, seadusandliku korra tagamisest ja finantstoetusest.

Artikli teoreetiline raamistik kasvab välja debatist, mis saab alguse Coase (1974) artiklist, kus pannakse peavoolu ökonomika seisukoht kahtluse alla. Peavoolu ökonomika (õpik) kasutab tuletorni näitena puhtast avalikust kaubast ja eeldab, et selliseid kaupu tuleks riiklikult pakkuda, või vähemasti nende tootmistahtu riiklikult reguleerida ja „tellida“ need kaubad riigieelarve tulude arvel. Coase (1974) näitab Briti tuletornisüsteemi ajaloolise kirjelduse abil, et tegelikult on tuletorne aastasadade jooksul ehitatud ja käigus hoitud erainitsiatiivil. Siit jõuamegi teoreetilise-empiriilise konfliktini. Arutelu olemasoleva kirjanduse üle nõuaks kõigepealt avaliku kauba selget definitsiooni. Kombineerides erinevaid olemasolevaid lähenemisi (näiteks Head 1974; Samuelson 1954; Buchanan 1975) jõuame optimaalse definitsioonini: (a) avalike kaupade tarbimine on mitterivaalitsev (ühe tarbimine ei vähenda teiste võimalusi tarbida); ja (b) välistamise võimatus (kui kaup on kättesaadav ühele, on ta koheselt kättesaadav ka teistele). Siit koorub ka põhiline probleem: nn „tasuta sõitmine“ ehk tarbijatel puudub ajend selliste kaupade eest maksta. Lisaks toob „tasuta sõitmine“ kaasa nn informatsiooni varjamise probleemi – tarbijal ei teki ajendit oma eelistusi avalike kaupade osas välja näidata, lootes, et seda teeb (ja ka kaupade eest tasub) keegi teine. Seega jääb teoreetiliselt turumehhanismi abil pakutavate avalike kaupade hulk väiksemaks, kui see oleks sotsiaalselt efektiivne (kui selliseid kaupu üldse pakutakse).

Artikli metoodikast: kasutatud on mittekonventsionaalset lähenemist majandusteoorias – analüütilist narratiivi. Selle mõiste toovad metoodilisse debatti Bates, Greif, Levi, Rosenthal ja Weingast (1998) oma samanimelises raamatus. Meetod on loodud ühendamiseks neid sotsiaalteadlasi, kes kasutavad kvalitatiivseid empiriilisi andmeid, kuid neid kasutatakse leidmaks üldisemaid seaduspärasusi läbi mänguteooria mudelite. Põhiliselt kasutatakse analüütilise vahendina laiendatud vorm mängu. Meetodi raskuspunkte on kaks: (a) allikate ekspertiisil põhineva loo (narratiivi) koostamine; (b) mudeli loomine, mis kajastaks tekkinud mängusituatsiooni. Meie artiklis on narratiivi aluseks peamiselt arhiivimaterjalid, kuid ka teised allikad (mälestused, intervjuud, nopped kirjandusest). Artikli analüütiline osa defineerib kõigepealt probleemi läbi mänguteooria vahendite – normaalvorm mängu – ja näitab, et probleem ei ole lahendatav (erainitsiatiivil pakkumist ei saa

olla) ilma mängu struktuuri muutmata. Mängu struktuuri on võimeline muutma vaid mingi „ülimuslik“ võim või institutsioon, meie juhtumi korral nimetame seda kokkuleppeliselt „riigiks“.

Narratiivist: kui Coase näitas, et Briti ajaloos on märkimisväärne arv juhtumeid, kus „tuletorninduses“ on domineerinud erainitsiatiiv, siis meie näide on veidi erinev. Võib ka väita, et tõlgendame erinevalt seda, mida me ajaloost teada saame, ehk küsimus ei ole tihti vaid omandisuhtes, vaid ka laiemas institutsionaalses raamistikus. Meid huvitab: (a) kelle initsiatiivil hakati tuletorni/e ehitama; (b) kes (era/avalik) ehitas; (c) kelle omandusse jäi tuletorn; (d) kes maksis teenuse eest; (e) kes määras hinna ja kuidas maksmist administreeriti. Nendele küsimustele erinevaid vastuseid saades jaotasime ajaloolise narratiivi neljaks osaks: 1) Süsteemi rajamine; 2) Eraomandus Vene impeeriumi ajal; 3) Natsionaliseerimine 19. sajandil; ja 4) Riigiomandus Eesti Vabariigi ajal.

Süsteemi rajamine sai oletatavasti alguse 16. sajandi esimesel poolel. Tulemärgid ei olnud küll päris tuletornid, ka võib eeldada, et omandi mõttes oli seal nii ühte kui teist (eraomanikke, munitsipaalomandust, seltsiomandust). Kõpu tuletorni hakati ehitama 1531. a. Tallinna Rae ja Hansa initsiatiivil. Torni ehitamine jäi majanduslanguse (Hansa venesuunalise kaubanduse lõppemise) tõttu pooleli, torni omanikuks jäi ehituse organiseerinud mõisnik. Hilisemal ajal sai ehitamise initsiaatoriks Rootsi riik, kelle kaubandus (ja ka sõjalised) huvid põrkusid Madalmaade huvidega. 1646. a. ehitati Sõrve ja Ruhnu puittornid. Ehitasid kohalikud mõisnikud, kes said selleks raha tellijalt. Riik finantseeris ehitust omakorda tuletornimaksudest, mida koguti kohalikest sadamatest. Kaubalaevad, mis randusid Riias, Pärnus või Kuresaares, maksustati kindlasummalise maksuga. Uus majanduskasvu periood oli 17. sajandi lõpus. Siiski võib allikatest leida, et 1750. a. oli Eesti territooriumil vaid kuus tuletorni: Kõpu, Keri, Suurupi, Pakri, Sõrve ja Ruhnu. Arvatavasti olid need kõik eraomanduses.

Teine periood – eraomandus Vene Impeeriumi ajal – algas 18. sajandil. Kõik meremärgid sh. tuletornid läksid formaalselt tsaaririigi Admiraliteedi alluvusse. Samas läksid Uusikaupungi rahulepingu kohaselt ka Kõpu, Ruhnu, Kolka (tuntud ka kui Domesnäsi) ja Vaindloo (tuntud ka kui Stenskäri või Seiskari) riigi käsutusse. Tegelikuses jäid omandisuhted muutmata (v. a. Vaindloo puhul) ja omanikeks jäid endised rootsi-balti parunid. Ilmselt jäi see nii, kuna Vene Tsaaririik otsis kohaliku aadlkonna toetust, säilitades nende rootsiaegsed privileegid. Kuni 18. sajandini säilis nn balti erikord endisel kujul. Endiste privileegide kohaselt läks pool riigi poolt kaubalaevadelt kogutud tuletornimaksudest omanikele. Ilmselt korjati tuletornimaksu tollimaksude ühe osana Pärnu, Kuressaare, Tallinna, Haapsalu ja Toolse sadamates. Tuletornide käigushoidmine jäi endiselt eraomanike hooleks. Ilmselt maksti neile eraldi ka hooldustasusid ja remonditasusid (vähemasti Kõpu tuletorni puhul). 18. sajandi teisel poolel ehitati erainitsiatiivil vaid üks tuletorn (Osmussaare). Oluliselt muutus olukord 19. sajandil.

19. sajandi natsionaliseerimise periood saab alguse muutustega balti-erikorras, mida initsieerib Katariina II. Võib oletada, et erakasumi vastane meeleolu võttis maad ka

laiemalt, näiteks kattub natsionaliseerimine ajaliselt Inglismaal toimuvaga (Taylor 2001: 750). Olulised on ka bürokraatlikud muutused. Tuletornide Järelevalveameti etteotsa määratakse Leonti Spafarjev, kes jääb sellele positsioonile 35 aastaks. Spafarjev moodustab kaks jaoskonda: Kroonlinna alluvusse lähevad Kotlini, Vaindloo, Suursaare tuletornid ja Revali alluvusse Keri, Suurupi, Pakri ja Sõrve. Võib eeldada, et ülejäänud tuletornid (näiteks Kõpu, Ruhnu, Osmussaare jne) on eraomanduses. Spafarjev kurdab, et eraomanduses olevad tuletornide tehnoloogia on vananenud ja nad takistavad ohutut meresõitu (Spafarjev 1820: 9). 1805. a. otsustabki Admiraliteet, et tuleb ehitada rida uusi tuletorne, rekonstrueerida olemasolevaid ja ühtlasi ka natsionaliseerida Kõpu tuletorn (Luige 1967: 28). Spafarjevi plaan viiakse peaaegu muutusteta ellu. Ehitatakse 13 uut tuletorni ja Mey (1936: 86) väidab, et enamus tuletorne Eesti territooriumil on riigistatud. Samas ei ole see eraomandi lõpp. Eraomandisse jäävad kaks Kolka tuletorni ja ka Kõpu. Lisaks Kõpule kuulub krahv Unger-Sternberg'ile tuletorne ka Paralepas ja Hobulaiul. Arhiiviallikate põhjal võib väita, et eraomandusse jäi ka Postrova tuletorn Peipsi rannikul. Kokku on 19. sajandi lõpuks Eesti territooriumil ligemale poolsada tuletorni või tulemärki. Samal ajal toimub tuletorniehituses tehnoloogiline muutus – kasutusele võetakse raudbetoon. Sajandi lõpul ehitatakse riigi poolt uue tehnoloogia järgi mitmeid tuletorne (tuntumad on Kihnu, Vormsi ja Tahkuna). Samal perioodil ehitatakse erainitsiatiivil ja finantseerimisel vähemasti kaks tuletorni – Harilaiule ja Käsmu. Põnev on see, et viimane kuulub kohalikule kogukonnale ja ehitamist rahastatakse purjutanud kaptenitele tehtud trahvidest.

Viimane periood Eesti Vabariigi ajal lõpetab eraomanduse. Tuletornindus liigub Transpordiministeeriumi alluvusse. Koos mõisamaadega riigistatakse ka Balti aadlkkonnale kuulunud tuletornid. Palgalehtede järgi võib öelda, et Tuletornide osakonnale kuulub algselt 34 tuletorni. Osakond tellib nende hooldamise ja parandamise erafirmadelt, tuletornivahid on aga riigiteenistujad. Alates 1934. a. luuakse Veeteedeameti alluvusse eraldi brigaad, mis asub tuletorne hooldama ja ehitama. Eesti Vabariigi viimase kaheksa aasta jooksul ehitab see brigaad 25 raudbetoonist tuletorni (Luige 1982: 72). Veeteedeameti tulud saadakse endiselt tuletornimaksudest. 1924. aasta Riigiteatajas on toodud diferentseeritud maksumäärad välis- ja kodumaistele alustele. Maksumäärasid diferentseeritakse ka purje-, auru ja mootorlaevade lõikes, ning maksu suurus määratakse tonnaži alusel. Tuletornimaksu tuli maksta vaid esimeses sadamas Eesti vetesse sisenedes ja see ei sõltunud edasistest sadamakülastustest. Kuigi tuletornid on riigistatud, leidub sellel perioodil erasadamaid: Kunda, Tallinn-Beckeri, Tallinna Balti laevaehituse ja Kärdla. Ka nendes olevate meremärkide hoolduskulud tasub riik. Samas töötavad nendes sadamates eralootsid. 1930. aastatel tõstatud poliitiline huvi viia tuletornid Kaitseministeeriumi alluvusse ja asendada tuletornivahid sõduritega, jääb Riigikogu toetuseta. 15. mail 1940. a. saadetud telegrammis annab Nõukogude Liidu Sõjakomandatuur teada, et vastavalt „lepingule“ võetakse üle Pakri, Osmussaare, Tahkuna, Ristna, Kõpu ja Sõrve tuletornid. Paari kuu pärast saadetud uues telegrammis antakse teada, et võetakse üle ka Suurupi kaks tuletorni, Naisaare, Keri ja Juminda. Ülevõtmiste nimekirjast selgub, et Nõukogude Liidu kätte läksid ka Hiiesaare, Kübarsaare, Viimsi, Roomassaare ja Papissaare tuletorn. Veeteedeameti likvideeriti 1. jaanuaril 1941. a., kõik tuletornid (kaasa arvatud juba varem mainitud)

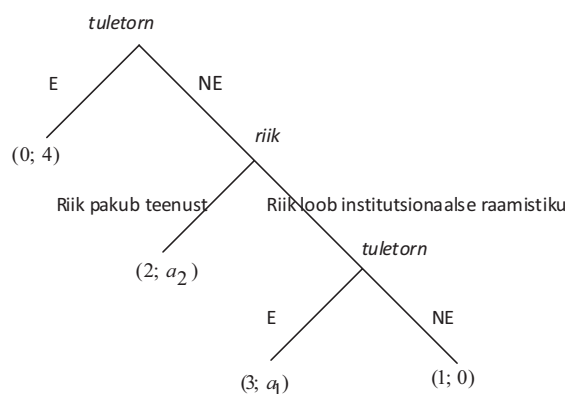
läksid loodud Merelaevanduse alluvusse. Luige (1967: 35) väidab, et selleks ajaks oli Eesti territooriumil 140 erinevat meremärki: 117 tuletorni, 20 valguspoid ja 3 tuletäeva.

Mudeli koostamisel tuleb kõigepealt probleem identifitseerida. Tuletornimäng on toodud joonisel 1. Kahel mängijal: *laeval* ja *tuletornil* on kaks valikut. Tuletorn saab pakkuda kvaliteetset teenust või mitte; *laev* saab maksta tuletornile või mitte. Vastavalt on b_1 tuletorni tulu ja $c(t)$ kvaliteetse toote pakkumise kulu, kus t on tehnoloogia näitajaks (mida spetsiifilisem tehnoloogia, seda kulukam on kvaliteeti pakkuda). C on valetulede (mittekvaliteetse teenuse) pakkumise püsikulu ning b_2 kvaliteetsetest teenusest saadav tulu *laevale*. Selles mängus on vaid üks Nashi tasakaaluline tulemusprofiil $(-C, 0)$, ehk *tuletorn* ei paku usaldusväärset teenust ja *laev* ei maksa. Mõlemad osapooled on lõksus (muidugi võib öelda, et valetulede omanikul ongi eesmärgiks laeva röövimine, see aga ei lahenda meie avalike kaupade pakkumise probleemi). Nagu ikka vangide dilemma tüüpi mängudes ei saa lahenduseks pakkuda informatsiooni sissetoomist mängu (näiteks *laev* esimesel etapil jälgib teenuse kvaliteeti ja maksab hiljem), sest see ei muuda *laeva* optimeerivat käitumist. Tüüplahenduseks tuuakse sellisel juhul strateegilisi lahendusi, mis eeldavad korduvat äritehingut ja nn reputatsiooniehitamist. Antud juhul on seda raske rakendada, kuna näost-näku äritehingut ei toimu.

		<i>Laev</i>	
		Maksta	Mitte maksta
<i>Tuletorn</i>	Usaldusväärne	$b_1 - c(t); b_2 - b_1$	$-c(t); b_2$
	Mitte usaldusväärne	$b_1 - C; -b_1$	$-C; 0$

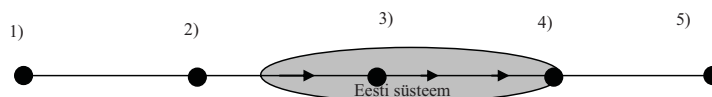
Joonis 1. Tuletornimäng.

Kuna mängu struktuuri saab muuta vaid piisava mõjuvõimuga „mängija“, siis meie poolt palutud lahenduses nimetame, seda *riigiks*. Riigi sissetoomine mängu muudab mängu struktuuri järgmiselt – esimesel etapil valib *tuletorn* kas efektiivse (E) või mitteefektiivse teenuse koguse/kvaliteedi (NE); teisel etapil järgib *riik tuletorni* valikuid ja otsustab juhul kui teenuse kogus või kvaliteet ei ole piisav, kas pakkuda ise või aidata kaasa institutsionaalse raamistiku loomisega. Viimases, ehk kolmandas etapis, saab jällegi *tuletorn* vastavalt riigi institutsionaalse raamistiku loomisele valida E või NE. Selles laiendatud vorm mängus (joonis 2) sõltub alammängu täiuslik Nashi tasakaal seosest a_1 ja a_2 vahel. Kui $a_1 > a_2$, tuleb *riik* erapakkujale nn appi ja mäng lõppeb tulemusprofiiliga $(3; a_1)$.



Joonis 2. Riik ja laiendatud tuletornimäng.

Narratiivi juurde tagasi tulles näeme, et ajalooliselt ongi *riik* sarnaselt mänguga Jooniselt 2 talitanud. Kokkuvõtlikult võib erinevate ajaloetappide kohta öelda, et tuletornide teenuseid ei pakkunud avalik või erasektor kunagi puhtalt. Joonisel 3 on Van Zandt'i (1991) „poolused“: 1) erapakkumine ilma igasuguse riikliku sekkumiseta; 2) erapakkumine koos riigipoolse omandi- ja lepinguõiguse jõustamisega; 3) erapakkumine koos valitsusepoolse tuletornimaksude kogumise administreerimisega; 4) riigipoolne pakkumine koos laevade tasutud tuletornimaksudega ja 5) riigipoolne pakkumine koos riikliku finantseerimisega.



Joonis 3. Eesti süsteem ja Van Zandt'i poolused.

Ajalooliselt on Eesti „tuletornindus“ nihkunud enama riikliku sekkumise suunas. Kindel on see, et riik on igal perioodil pakkunud eraturgudele enam kui lihtsalt omandiõiguse kaitset – on määranud tuletornimaksu ja selle kogumist administreeritud. Miks on aga sellest „minimaalsest“ institutsionaalsest raamistikust kaugemale mindud? Mudel ja ajalooline narratiiv näitavad, et põhjusi on kaks: tehnoloogia muutus ja avalik huvi. Tehnoloogia areng tõi kaasa spetsiifilise oskuse ja teabe vajaduse, mis võis muuta avaliku spetsialiseerunud brigaadi kasutamise tuletorni ehitamisel suhteliselt odavamaks. Avalik huvi (olgu see siis Vene Tsaaririigi sõjaline ambitsioon või Hansa ja Eesti Riigi kaubandushuvid) nõudis, et tuletornide pakkumise mehhanism võimaldaks enam tuletorne kui „miinimummehhanismiga“ toetatud eraturud oleksid pakkunud.

Lõpetuseks võib öelda, et debatt selle üle, kas avalikke kaupu peaks pakkuma riik või eraturg, ei ole valik musta ja valge vahel. Peame arvestama, et avalike kaupade puhul on selge see, et vaid „minimaalriigi“ (Nozick 1974) abiga eraturud sellistes valdkondades hakkama ei saa. Lisaks on vaja ka mingit „abipaketti“. Tuletornide puhul olid miinimumpaketis sees riigipoolne abi tuletornimaksude määramisel, nende kogumisel ja maksude administreerimisel. Kui aga avalik huvi nõuab enamat kui miinimum, siis peab ka pakett kasvama. Tuletame meelde, et sarnaseid avalikke kaupu ei olegi nii vähe: haridus, linnaruum, mitmed loodusvarad ja palju muud.