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On the origins of vertical unbundling: The case of the French transportation industry in the nineteenth century

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1. Introduction

On 1 January 2010, international railroad passenger traffic was liberalized in all the member states of the European Union (EU). After the liberalization of freight traffic, it was the last development of the European Commission policy launched in the early 1990s that aimed to introduce competition in the public utilities. A series of legislations imposed a vertical de-integration also called vertical unbundling (or simply unbundling), which can be defined as separating infrastructure, which remains a monopoly, from services so that independent train operators could compete over common or parallel tracks.[1] Hence, for the railroad industry, the EU Directive 91/440 imposed the unbundling of *infrastructure* from 'the

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1 This means that, prior to unbundling, infrastructure and services were vertically integrated and managed by a single monopoly. In the railroads, infrastructure is comprised of the 'works which constitute the body of the road'; that is, 'rubble, embankments, tunnels' and construction works 'similar to those who would be necessary for a road' (Deharme 1890: 47). Infrastructure comes with the superstructure, which is comprised of 'the road, the ballast, the stations along with facilities' – like switching, signaling and security equipments – and also rolling stock (Deharme 1890: 47). The services designate the transportation of merchandise or passengers (and related activities such as loading/unloading) from a point A to a point B along with management of commercial operations like booking and customer service.

operation of transportation services of railroad companies'.[2] The EU Directive 96/92 did the same for electricity, Directive 98/30 for gas, and Directives 90/387, 90/388 and 96/19 for telecommunications.

When was vertical unbundling implemented for the first time in public utilities? Can we retrace its origins? It is important to stress that in the nineteenth-century literature, as I demonstrate in this paper, vertical unbundling is related to the issue of natural monopolies regulation. In effect, after identifying a natural monopoly situation, some economists discussed the question as to whether an industry had to be unbundled. An industry is considered a natural monopoly when, due to high fixed costs, economies of scale exist for the whole range of market demand. In this case it is more efficient to have one company serving all of the market instead of several companies that would serve only a part of it. But in network industries like railroads, energy or telecommunications, the monopolist abuses its power by selling at higher prices and producing lower output in comparison with prices and output in a competitive situation.

The origins of the natural monopoly were retraced in a seminal paper by Mosca (2008), but to date no specific research has been made to analyze the origins of vertical unbundling – although this unbundling was developed in conjunction with the concept of natural monopoly. This paper fills this gap in the literature in analyzing the case of the railroad industry in France from the perspectives of legislation and economists of the nineteenth century. The focus on railroads lies in the fact that, throughout this period, the railroads were created and progressively surpassed inland waterways in terms of passenger and freight traffic. Moreover, the economists' work on vertical unbundling specifically focused on the railroad industry in comparison with the inland waterways and roads. It did not concern other network industries such as energy or telegraphs. I argue that vertical unbundling emerged in the nineteenth century with legislation pertaining to inland waterways and railroads. This was particularly the case for the railroad industry due to pricing and competition rationales. Economists like Dupuit and Walras agreed that infrastructure and services had to be unbundled for the inland waterways. In contrast, they expressed different justifications to defend the monopoly for the railroad industry.

My research is of interest on two counts. I show that vertical unbundling goes back to the nineteenth century and therefore is not a recent principle.

2 According to Term 1, there are three different systems: the accounting unbundling is compulsory, and institutional unbundling (the removal of capitalistic ties between entities) and organic unbundling (holding company–subsidiary relationship) are optional.

I also shed light on the interplay between theorists' work and legislation during this period. Following a chronological order, the first section explores the origins of vertical unbundling in the French railroad legislation of the nineteenth century. The second section analyzes the views of Dupuit and Walras.

2. The origins of unbundling in the nineteenth-century legislation

In French railroad legislation, vertical unbundling drew upon two complementary rationales: pricing and competition.[3] The pricing rationale appeared in 1835. The concession book imposed to the contractor of the line from Paris to Saint-Germain-en-Laye (and to all the future concessions) distinguished in the 33rd clause a toll (which represented two-thirds of the total price) from a transportation fare (which represented one-third of the total price) (Ribeill 1997: 32).[4] These 'split fares' were established with the anticipation that the toll would be paid by other competitors using the tracks of the main contractor upon the principle of free competition contained in Clause 42. The tax system is another reason that corroborates the distinction of the toll from the transportation fare: an Act of 2 July 1838 created a tax on each ticket; this tax had to cover the transportation fare only (Ribeill 1997: 32).

The competition rationale expressed in article 33 stated that 'to reimburse the company for the construction works and expenses that it plans to do, the state allows the company to receive the tolls and the transportation fares' (Ribeill 1997: 32), the latter are received 'in case the company makes the transportation at its own expense and by its own means' (1997: 32).[5] Furthermore, the 41st Clause specified that 'any future construction of road, waterway, railroad, in the area where the railway is located, will not be considered as a reason for reimbursement by the company' (Ribeill 1997: 32). Finally, the 42nd Clause – called the 'free travel' clause – was aimed at 'preventing any de jure or de facto monopolies from the companies' (Ribeill 1997: 29). This clause enabled the state to allow the construction of parallel infrastructure akin to the first railroads, but this threat of potential competition has not been implemented. Thus, it clearly appears that in the nineteenth century the legislation of the

3 For an extended analysis of French railroad legislation and concession contracts in the nineteenth century, see Numa (2009a).

4 The toll covers the infrastructure costs (construction and maintenance) whereas the transportation fare covers the costs of commercial activity.

5 Unless noted otherwise, all translations of non-English texts and authors are mine.

railroads anticipated a form of intermodal competition (Clause 41) and the two forms of intramodal competition; that is, the possibility to build parallel infrastructure (Clause 41) along with the possibility for a competitor to use the railroads used by the main contractor (Clause 33). Unfortunately, this will to preserve competition between carriers did not become a reality. Some outstanding theorists and managers of the railroads, such as Bricka (1894: 397), Colson (1903: 136) and Picard (1918: 499), considered that there could have been security problems.[6]

The engineer Alexis Legrand was responsible for integrating these two rationales into the French railroad legislation. In 1835, as director of the Ponts et Chaussées et des Mines, he was charged with writing the concession book and naturally was one of the three signatories of this document along with the Minister of Interior Adolphe Thiers and the concessionaire Emile Péreire (Chemin de fer de Paris à Saint-Germain 1835). Most projects pertaining to the means of communication submitted to the Chambre des députés (the French equivalent of the House of Representatives at that time) had his mark. Between 1839 and 1847, he was sous-secrétaire d'Etat aux Travaux Publics, a cabinet-level position for the Public Works specially created for him. After interminable debates among lawmakers, it was under his tenure that the national railroad network with Paris as its center was created. The project that he designed, named 'Legrand's star', eventually served as basis for the 1842 'Railroad Charter Act'.[7]

3. The analysis of Dupuit and Walras

How did the nineteenth-century French theorists deal with vertical unbundling after identifying a natural monopoly situation? The writings of Dupuit and Walras are enlightening. Although they did not provide an extensive analysis of this issue, there are the first and only authors to

6 Details about these security problems are sketchy. Bricka, Colson and Picard might have considered that switching techniques were not developed enough to manage a heavy traffic caused by the circulation of competitive trains.

7 This act was an original model of Public–Private Partnership (PPP) as the state was to pay for the 'lands and facilities, excavation works, architectural works and stations will be paid by the state' (5th Clause), while 'the tracks . . . , the equipment and operation expenses, maintenance expenses and reparation of the railroad . . . [were to be] in charge of the companies whose operation of the railroad will be contracted out'. However, this form of PPP was not carried out, as the state directly contracted with the companies for both construction and operation of the railroads, due to a legislative amendment initiated by the *député* Prosper Duvergier de Hauranne (Picard 1884: 279–81).

address it;[8] therefore their respective contribution deserves attention. For the roads and inland waterways, they argued that infrastructure and services should be unbundled. Infrastructure is more effectively owned by one operator whereas anyone can be a carrier; that is, competition is the norm. In contrast, for the railroad industry they expressed different justifications to defend a vertical monopoly of infrastructure and services. For both Dupuit and Walras, the debate on the relevance of unbundling in the railroad industry is closely related to the natural monopoly. Also, one should bear in mind that the French legislation of the inland waterways and canals allowed free competition between companies (in exchange for the payment of navigation taxes removed in February 1880), counter to the case of railroads that consisted of regional monopolies of a 99-year period.

3.1. Dupuit's de facto monopoly

The French engineer-economist Jules Dupuit was one of the first authors to identify a natural monopoly throughout the concept of '*de facto* monopoly' (Numa 2012). He analyzed it in two articles published in the second volume of the *Dictionnaire de l'Economie Politique* and confirmed his positions in front of his peers of the Société d'Economie Politique.[9] Dupuit perfectly understood what was a natural monopoly in this context situation when he argued that the 'means of transportation whose construction and operation need tremendous expenses are necessarily monopolies, and the proprietor of a … monopoly can draw a revenue from it that is superior to that of capitals submitted to competition' (1853a: 340). For Dupuit, it was more efficient to have one company serving all the market instead of two serving only a part of it because 'the new company would have significantly harmed the incumbent one … instead of a good deal, there would be two bad ones' especially in the railroad industry (1853a: 340). For this reason Dupuit clearly recommended state intervention in the entry 'Means of transportation' of the *Dictionnaire*: 'every transport means that is a monopoly must be operated by the state, every transport means that is accessible to competition must be operated by private industry' (1853b: 854).[10]

8 I carefully and extensively explored the French engineer-economists' literature without finding any reference to vertical unbundling other than those of Dupuit and Walras.

9 See Dupuit (1853a, 1853b) and Société d'Economie Politique (1853).

10 '*Toute voie de communication qui est un monopole doit être exploitée par l'Etat, toute voie de communication qui est accessible à la concurrence doit être exploitée par l'industrie privée*'.

In the same entry, he distinguished infrastructure and services mentioning that 'a mean of transportation … is made of the route, the vehicle and the engine' (Dupuit 1853b: 847). Even though he did not use the words 'infrastructure' and 'services', the route was for him an element of infrastructure while the services are provided by the vehicle (the car) and the engine, which are indivisible because the engine makes the vehicle work. Then Dupuit considered that:

> for the canals … the building expense … is significant enough that the capital interest required is a notable proportion of the transportation price [paid by the client]. But the owner is not the carrier; anyone can settle and use his boat; the competition works on the whole part of the transportation price [paid by the client] which corresponds to the transportation fare. (1853b: 847)

This means that, in the inland waterways, the importance of infrastructure expenses justified the presence of a single owner; one should recognize a natural monopoly situation. Instead 'the owner is not the carrier', and therefore competition could and had to operate between boatmen for the transportation activity. In terms of pricing, the consequence was the distinction between the toll and the transportation fare.

Dupuit drew upon the concept of '*de facto* monopoly' to justify the monopoly regime for the railroads, a monopoly that should be controlled by government. He was consistent on this issue in the *Dictionnaire* and before his peers of the Société d'Economie Politique. Although Walras later criticized Dupuit, he also defended the same idea using a different approach.

3.2. Walras and the double natural monopoly

Walras explored the monopoly of the railroads and its characteristics in his article entitled 'The State and the Railroads', in particular citing the work of J.S. Mill (1848).[11] For him natural monopolies are either 'moral monopolies' or 'economic monopolies'. The former corresponds to public utilities while the latter are 'private monopolies turned into state monopolies or monopolies contracted out by the state' (Walras 1875: 189). The adjective 'natural' is used repeatedly without accurate definition. From his perspective, the railroad industry was more than a commercial activity – it was also a public utility because it was useful for national defense, for national unity and was an essential agent of civilization and progress. Consequently, railroads must be nationalized because the owner of the routes is in monopoly situation, which means he would manage at the detriment of the public, reducing consumer utility. A private monopoly

11 On the natural monopoly in Mill's work, see Numa (2010).

does not use its profit to open lines with uncertain return and imposes higher prices than under competitive situation. State management and operation of railroads would have two benefits: lower prices and faster establishment of the network – things that the market cannot accomplish under competition.

The justifications provided to make railroads a public utility can be called into question. One can imagine that the railroad industry was a strategic weapon useful for moving men and equipment during periods of war. But the argument that described the railroads as public utility because they were a source of national unity and an essential agent of civilization and progress is not convincing. One can reply that private companies can achieve the same result (Béraud 2004: 20).

An important fact to mention about Walras' article is that, in his view, railroads constituted a double natural monopoly (Numa 2009b). In the last paragraph of the second part of the article entitled 'Railroads as Public Utilities and Economic Monopolies', Walras started out distinguishing two types of means of transport. For the first one, he implicitly introduced an infrastructure – services unbundling: at the infrastructural level, competition is not possible owing to wasteful duplication of infrastructure, and because railroads are public utilities. In contrast, services can be subject to competition. Roads and canals fit with this first type:

> if the road and canal … are a natural monopoly, at least the transport that operates fits with the conditions of competition due to the fact that an indefinite number of cars and boatmen can drive on the road or ship on the canal. The toll … is paid to a monopolist; but the freight is paid to competitive entrepreneurs. (Walras 1875: 200)

For the second type of means of transport, Walras cited the railroads that, counter to the roads and canals, form a double natural monopoly. Thus, for the railroads:

> the route is a natural monopoly and the transport is another essentially linked to the former because, as I posited, an indefinite number of companies cannot use the tracks to run their trains of passengers and merchandise. In this case, the rent of the track, cars and engines, the toll, and the freight are all paid to a monopolist. For all these reasons, it is therefore a real aberration to invoke freedom of industry in the railroads. (Walras 1875: 200).[12]

12 Walras' original words in this paragraph are: 'l'*établissement et l'exploitation d'une voie ferrée, comme ceux d'une route ou d'un canal, échappent donc par nature à la concurrence. Mais il y a plus: si la route et le canal, considérés en eux-mêmes, constituent un monopole naturel, au moins la traction qui s'y opère rentre dans les conditions de la concurrence par la raison qu'un nombre indéfini de voitures et de bateliers peuvent rouler sur la route ou naviguer sur le canal. Le péage, si on le maintient, se paie à un*

In his mind, railroads differ from other industries in the sense that they constitute a double natural monopoly that require state intervention. He relies upon three justifications to lay down the idea of double natural monopoly. The first two are explained by the fact that, in the railroad industry, infrastructure and services are each a monopoly and these two monopolies are connected because 'an indefinite number of companies cannot make circulate their trains of travelers and merchandise on the tracks'. Consequently, railroads are a 'natural and necessary monopoly' (Walras 1875: 208). This monopoly can be nationalized or managed by a private company for the account of the state. Moreover, as a third argument, Walras argued that the railroad industry were also a public utility based on the justifications we discussed above.

3.3. Waterways versus railroads

In the nineteenth century, eminent natural monopoly theorists like Dupuit and Walras leaned toward unbundling the inland waterways. Regarding the railroads, they all converged to consider that both infrastructure and services should be managed under the monopoly regime. In the nineteenth century, no author suggested unbundling infrastructure and services for the railroads. So why did economists treat inland waterways and railroads differently with respect to vertical unbundling? First and foremost, the French legislation of the inland waterways and canals, in fact, preceded the economists as it allowed free competition between companies (in exchange of the payment of

monopoleur; mais le frêt se paie à des entrepreneurs concurrents. Dans les chemins de fer, au contraire, la voie constitue un monopole naturel et la traction en constitue un autre essentiellement lié au premier par la raison que, comme nous l'avons dit, un nombre indéfini de compagnies d'exploitation ne peuvent faire circuler sur les rails leurs convois de voyageurs et de marchandises. Ici, le loyer de la voie et le loyer des véhicules et des moteurs, le péage et le frêt, tout se paie à un monopoleur. C'est donc, par tous ces motifs, une véritable aberration que d'invoquer la liberté de l'industrie en matière de chemins de fer'. Ekelund and Hébert's translation of the previous quote is truncated and erroneous. They write: 'the establishment and operation of a railway, like that of a highway or canal, escapes competition by its very nature. But there is a difference: if the highway and the canal constitute a natural monopoly in and of themselves, at least competition might exist between entrepreneurs on return traffic because roads and canals can accommodate an unlimited number of cars and/or boatmen. On the contrary, the tracks of a particular railroad constitute a natural monopoly because the company that owns the track does not allow other companies to ship passengers and merchandise on it. In this case, the rent of the track, cars and engines, the toll, and the freight are all paid to a monopolist' (Ekelund and Hébert 2003: 666, footnote 20). It does not faithfully transcribe Walras' words on the double natural monopoly of the railroads.

navigation taxes removed in February 1880), counter to the case of the railroads for which the operation is made via long-term concessions. Therefore, in the case of inland waterways, it was a clear implementation of vertical unbundling. Second, Dupuit and Walras mentioned security problems that may have occurred in the case where trains of different companies circulated on the same tracks, just like several analysts argued. Dupuit and Walras underlined the necessity to some overall coordination between infrastructure ownership on the one hand, and the use of the tracks for transport services on the other. In practical terms, it means that it was not possible to dissociate the two activities. It is easy to understand that tracks cannot be used for any other activity except transporting travelers or merchandise. Consequently, infrastructure and services are strictly complementary. The operator that owns the former must be that who provides the latter. This is not always the case for inland waterways because they could be used for activities other than transport. For example, I found a couple of authors who mentioned inland waterways could be used for agricultural irrigation (Teisserenc de Bort 1843, Perdonnet 1865).

In France it was only in 1873 that a legislation based on the *Cézanne report* endorsed the impossibility for two or more railroads to compete with each other.[13] In effect, Cézanne reported that 'one should not talk about competition for the railroad industry' (1873: 13). Admittedly 'there are situations where, even between two railroad companies, a temporary competition will take place … but these competition situations are quite rare exceptions' (Cézanne 1873: 15). Cézanne added *vis-à-vis* the railroads that the principle of non competition 'absolutely complies with the theory instructed by the masters of economic science' (1873: 14). Curiously, the report relies upon J.S. Mill's *Principles* but does not mention Dupuit, who was also an engineer of the Corps des Ponts et Chaussées like Cézanne. Cézanne cited a famous excerpt of the *Principles* in which Mill exposed the natural monopoly:

> There are many cases in which the agency, of whatever nature, by which a service is performed, is certain, from the nature of the case, to be virtually single; in which a practical monopoly, with all the power it confers of taxing the community, cannot be prevented from existing. I have already more than once adverted to the case of the gas and water companies, among which, though perfect freedom is allowed to competition, none really takes place, and practically they are found to be even more irresponsible, and unapproachable by individual complaints, than the government. There are the expenses without the advantages of plurality of agency … and it is the part of government, either to subject the business to reasonable conditions for the

13 The *Cézanne report* was issued on 8 February 1873. The law that derived from the report was published in the *Journal Officiel* of 20, 21 and 22 February of the same year, becoming effective on those dates.

> general advantage, or to retain such power over it, that the profits of the monopoly may at least be obtained for the public. This applies to the case of a road, a canal, or a railway. (Mill 1965 [1848], Book 5: 955–6)

4. Conclusion

Three comments can be made in relation to vertical unbundling, the concept of natural monopoly and the notion of competition in the railroads.

Already in the nineteenth century, the economists identified natural monopoly situations. For the inland waterways, they limited it to the infrastructural level while services could be subject to competition. This was already the case since 1820, as legislation pertaining to canals allowed free entry and free operation while infrastructure was held by public or private monopolies. On the contrary, economists defended another measure for the railroads. Well-known authors such as Dupuit, Walras and Hadley identified natural monopoly situations. Using various arguments, they recommended the monopoly regime. But the theoretical discussions coming from economists on unbundling came after the legislation. The unbundling principle was already contained in railroad legislation on pricing and competition rationales. However, even if economists' analysis on vertical unbundling came after legislation, their positions prevailed as, in fact, no competition between carriers was possible (even the exception of the line Paris–Versailles failed as it eventually ended up in a merger). All in all, the origins of unbundling go back to the nineteenth century with legislation pertaining to inland waterways and railroads. Therefore it is not a new principle. In the nineteenth century, I did not find any legislative or theoretical origins of the unbundling principle in other network industries like telegraph, water or gas. If Dupuit and Walras were the only French authors to tackle the issue of unbundling, one question that comes to mind is whether the topic was addressed abroad.[14] It may be a possible lead for future research. Something is certain, Dupuit and Walras were the first to

14 For example, Hadley (1886) also distinguished infrastructure and train operations for the transportation networks, which he described as natural monopolies. He considered that transportation history consisted of two periods. In the first, which corresponded to the roads and waterways, 'the highway and the carrier were sharply distinguished. The highway, whether road or river, would have constituted a natural monopoly, if it had been made the subject of private ownership' (Hadley 1886: 29). It is what Hadley called 'the general law of transportation'. The second period corresponded to the railroad industry and telegraphs. For these two industries, 'it was an obvious advantage, if not a necessity, to have the line and the business owned and controlled by the same head' (Hadley 1886: 30–1).

discuss it although I admit the justifications were not extensively discussed. I suspect it is because it was obvious to most railroads analysts (if not all of them at that time) that unbundling was neither possible nor desirable. I did not find a single author who opposed these views.

As regards the natural monopoly concept, I demonstrated that theory came first (thanks to Dupuit and Walras), and then legislation and rulers adopted it as an argument against implementing competition in the railroads. It happened in 1873 with the *Cézanne report* and the subsequent law it originated right after. Accordingly, my paper definitely rejects Dilorenzo's argument claiming 'it is a myth that natural monopoly theory was developed first by economists, and then used by legislators to 'justify' franchise monopolies' (1996: 43). There is no myth here. The truth is the theory was not an *ex post* rationale for government intervention (as Dilorenzo pretends) but an *ex ante* justification for state interference.

Finally, this article recalls that competition in the railroad industry has a specific meaning. Legislative and theoretical debates highlighted what I can call a Marshallian conception of competition. As indicated by Groenewegen (2003), Marshall maintained in the *Principles* (1890) and in *Industry and Trade* (1932 [1919]) that competition somehow entails a subtle mix of cooperation between producers (possibly up to concentration) and state interference. It seems to me that competition in the railroads fits very well with Marshall's conception.

One question may be of interest for future research: how can we explain the re-emergence of vertical unbundling in the twentieth century?

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Abstract

This paper retraces the origins of the unbundling of infrastructure, which is a monopoly, from services, which are subject to competition. Using the case

of the railroad industry in France, I examine how both natural monopoly theorists and legislation dealt with this subject in the nineteenth century. I argue that the origins of vertical unbundling date to this period with legislation pertaining to inland waterways and railroads. This was particularly the case for the railroad industry due to pricing and competition rationales. I analyze the writings of Dupuit and Walras, and show that they both agreed that infrastructure and services had to be unbundled for the inland waterways. In contrast, they expressed different justifications to defend the monopoly for the railroad industry. Following a chronological progression, the first section explores the origins of unbundling in legislation. The second section analyzes how theorists approached the way railroads had to be managed. Throughout, I highlight the interplay between their work and legislation.

Keywords

Unbundling, natural monopoly, railroads, regulation, infrastructure, services, inland waterways

JEL Classification

B10, D42, L51, L92