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The train sector in Belgium:

Is competition an efficient solution for improving the Belgian rail performance?

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Abstract

More than ever before, transportation and its ecological footprint is at the centre of debates. Following the European Commission's implementation of the Fourth Railway Package, the question of performance improvement is addressed. After a review of the literature about competition impact on the railway sector, this thesis focuses on the possible alternatives to enhance performance in railway. The analysis includes a comparison of train sectors in Belgium, the Netherlands, Switzerland, Denmark and Austria and clarifies the potentials impacts of competition implementation. This will reveal a lack of investments along with potential misallocation of funds for Belgium. Finally, the main issues of Belgium passenger rail market are addressed. Competition might help the railway in Belgium to perform better but, as a pre-requisite, other issues need to be addressed in order to observe the positive impacts of competition.

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"Driving the train doesn't set its course,

the real job is laying the track."

Ed Catmull

Part I

Introduction

In the current context, we are, more than ever before, trying to find new ways to reduce our environmental footprint. We throw a lot of money into research for less polluting processes, more suitable alternatives, and - sometimes desperatly - research for new technologies that would magically solve all our problems. However, the humankind sometimes forgets that the solution does not always rely on new technologies, but on how to do things we already do, differently. And the transportation sector is no exception to the rule. This is the main reason why this thesis focuses on the railway. Because railway has been, is and will always be an important, convenient and eco-friendly way of transportation.

It is a fact that the European Commission fully understands the issues at stake. For years, it has implemented multiple directives in the hope of reforming the European Railway Market into a more efficient, suitable, cheaper, performance-driven and competitive market. Its hope was to raise the number of commuters, travellers, and tourists deciding to use the train instead of the car to get from one place to another.

Nevertheless, some countries have shown a lack of enthusiasm perhaps even reluctance to comply with the directives. Belgium, for instance, does not set a good example, with only one company operating on the passenger market. It practices no competition whatsoever, and does not perform well compared to countries with similar parameters.

In this respect, you will find a thorough examination of the railway sector, the multiple directives and the potential impacts of competition followed by an analysis that assesses whether competition would help Belgium to perform better.

Part II

Overview

1 Justification for Analysis

1.1 The Railway Packages

First and foremost, it is necessary to understand why the goal of this thesis aims at analysing the impact of competition on Belgian rail performance. This is linked to the concept of Railway Packages, which is defined later. The choice of focusing on competition is not random and the main reasons are set out in the next chapters. A short history and specificities of the railway market to enable full comprehension of important concepts are described below.

1.1.1 History and specificities of the railway market

The rail transportation market has its own particular specificities. From a historical perspective, a lot of countries have exhibited the same pattern. Regional train companies evolved into national ones mostly during the first half of the 20th century [Pellegrini and Rodriguez , 2013]. From that moment on, they formed a monopoly. But in the 1990's, privatisation made its "come-back". The main reason derives from the constant decline of the rail transport market share in comparison with other transport modes over a period of more than 30 years. Compared to the other industries, the rail sector grows slowly, if there is any growth at all [Deville and Verduyn , 2012].

The decline of the rail sector can be explained by various of factors. These can be distinguished into two different categories; the external factors such as the transformation of other industries and policies and investment favouring road over rail; and internal

factors, such as the absence of cross-border cabotage[1], the lack of one-stop shop in path allocation[2] and the lack of competition amongst others [Di Pietrantonio and Pelkmans , 2004; Nash and Rivera-Trujillo , 2004]. But for Deville and Verduyn , 2012, the decline observed also came from the rail sector itself, from the fact it was still widely nationally organised despite passengers and transport needs becoming increasingly international [Deville and Verduyn , 2012]. The rail sector might face strong competition from other transportation sectors but it is not the only reason for its decline. Its management was also questioned by the European Commission. Last but not least, the railway sector is a highly capital intensive industry, which employs a significant number of people. Therefore, strong regulatory measures are necessary. [Maczkovics , 2017]

Short note on liberalisation and privatisation. In the rail sector, the notions of liberalisation and privatisation are commonly confused. To avoid the mistake of miscomprehension, you can find here a short explanation of the two concepts :

- The liberalisation of a market can be understood as the opening of that market to competition.
- The privatisation of a market consists in privatising the firms operating on this market by transferring the shares from public to private firms [Malay and Keirsbilck , 2019].

Both notions can be implemented simultaneously but they do not necessarily have to. You can be in a privatised but not liberalised scenario, resulting in a private monopolistic market as well as in a liberalised but not privatised one[3].

[1]Cabotage is the transport of goods or passengers between two places in the same country by a transport operator from another country

[2]Where it is decided which trains are allowed to use which tracks and when.

[3]In Belgium, Proximus or Belfius have undergone the liberalisation process but still belong to the state while competing with private firms in their respective markets. [Malay and Keirsbilck , 2019]

1.1.2 Single European Railway Area

The multiplicity of the problems faced by the train sector prompted the European Commission to reform it. The objectives were the following : creating a genuine internal rail market, improving the efficiency of rail companies and fostering a policy of sustainable mobility [Deville and Verduyn , 2012].

With this in mind, combined with the intention to create an internal market for transport via a common transport policy, the European Commission established basic principles in the founding Treaty, signed in Rome in 1957 [Deville and Verduyn , 2012]. Since then for 20 years and counting, the European Commission has been implementing Railway Packages. To this day, four of them have been implemented.

Starting in 1993, the European Union (EU) introduced a set of new legal requirements on the licensing of railway companies. If the licence was obtained in one of the future Single European Railway Area (SERA)[4] members countries, it was valid in all member countries [Tunnicliffe , 2019]. Enabling rail operators to have access to the trans-European network on a non-discriminatory basis was the goal, and this has been implemented in 2001 [European Commission , 2020].

Then in 2004, the second package was aimed at harmonising standards and increasing interoperability [Tunnicliffe , 2019]. Its goal was to create an integrated European rail area in both legal and technical terms [Deville and Verduyn , 2012]. The Commission also proposed to establish a European Railway Agency (ERA) that would be responsible for providing technical support for the safety and interoperability work [European Commission , 2020].

Following the White Paper on European transport policy for 2010, the third Railway Package was adopted in October 2007. While the previous packages focused on the freight transportation, the objective of the third package was to finally open up pas-

[4]We will understand later on that the "SERA" is still a concept, far from being completely implemented.

senger transport to competition in the European Union [Deville and Verduyn , 2012]. It also introduced open access rights for international rail passenger services including cabotage by 2010." [European Commission , 2020].

1.2 The fourth Railway Package and its pillars

In the context of this thesis, the focus is on the fourth Railway Package and its implication, which is thought to be the most ambitious and wide-ranging of all, and a significant step towards a SERA [Tunnicliffe , 2019]. The overarching goal of the fourth Railway Package is to revitalise the rail sector and make it more competitive towards other modes of transport [European Commission , 2020] and by that, counteracting the constant decrease of the modal part of the train sector observed [Deville and Verduyn , 2012]. The adoption process of the fourth Railway Package spanned four years of lively debates. But for Carole Maczkovics, the long standing legislative process focused more on reducing the European Commission's rather rigid proposals than on identifying and addressing the cause for the relatively poor modal share retained by the railways. It is constituted of two different pillars, the technical pillar and the market pillar. [Maczkovics , 2017]

1.2.1 The technical pillar

The technical pillar, for which the agreement was reached in 2015 [Maczkovics , 2017], is meant to significantly reduce costs linked to the administrative burden faced by operators willing to undertake transportation all across Europe [European Commission , 2020].

The most significant development under the technical pillar is the increase in powers for the European Union Agency for Railway (ERA)[5] through EU Regulation 2016/796 (Safety Directive) [Maczkovics , 2017]. Introduced in the second package, the ERA is now able to issue vehicle authorisations and safety certifications, previously issued

[5]Previously named The European Railway Agency.

separately by each National Safety Authority (NSA). It is also aimed at creating a "One stop shop" which acts as a single entry point for all such applications, using easy, transparent and consistent procedures [European Commission , 2020].

Aside from increasing the powers of the ERA, the new Safety Directive aims at clarifying the distribution of roles among rail stakeholders. A major novelty in the Safety Directive relates to the progressive phasing out of national rules. Member States may still adopt national safety rules, but only under exceptional circumstances where no EU rule exists or as an urgent preventive measure, for instance, after an accident. The objective is to harmonise safety rules at EU level [Maczkovics , 2017] along with reducing the number of national rules that could act as entry barriers for non-national operators.

A third directive, relating to interoperability has also been revamped. The Interoperability Directive's main objective is to attain an optimal level of technical harmonisation and make it possible to facilitate, improve and develop international rail transport services within the EU and with third countries, as well as contribute to the progressive creation of the internal market and the completion of a Single European Railway Area. National Safety Authorities remain competent to authorise fixed installations within their territory except for ERTMS (European Rail Traffic Management System) elements [6], which are now to be authorised by the ERA [Maczkovics , 2017;European Commission , 2020].

1.2.2 The market pillar

The market pillar is the core reason for this thesis focusing on competition and performance. The fourth directive which was intended to complete the process of opening up to competition, started nearly twenty years ago. For the European Commission, competition in rail passenger service markets is important to encourage railway operators to become more responsive to customer needs, improve the quality of their services and their cost-effectiveness. The market pillar is expected to deliver more choice and

[6]Safety system that enforces compliance by the train with speed restrictions and signalling status

better quality of rail services for European citizens, these being the overriding objectives [European Commission , 2020].

But due to their complexity and impact on the market, the various regulations under the fourth directive proved to be the biggest hurdle in reaching agreement between the institutions and were formally adopted on 14 December 2016 [Maczkovics , 2017]. But has it achieved what it sets out to do and are the results of its implementation going in the right direction?

Short note on competition *for* and *in* the market

Competition in the railway market can take 2 forms :

- Competition *for* the market, characterised by competitively tendered public service contracts[7], where the competitive tendering of public service contracts will enable savings of public money [European Commission , 2020].
- Competition *in* the market, characterised by open access[8] [Malay and Keirsbilck , 2019].

For the European Commission, competition *in* rail passenger service markets will encourage railway operators to become more responsive to customer needs, improve the quality of their services and their cost-effectiveness [European Commission , 2020]. The fourth directive actually combines both types of competition but does not establish any upfront hierarchy between open access and public service [Maczkovics , 2017].

The market pillar of the fourth Railway Package is complex. For the sake of clarity, the description will be quite concise compared to the many regulations it includes.

First, we will analyse how the two types of competition are supposed to work together. Although this part of the package was not favourably perceived by many Member States;

[7]A public service contract (PSC) formally refers to the (contractual) relationship between the commissioning public transport authority (i.e. the public authority or the organising entity) and the public transport operator. [Egger and Auerbach , 2009]

[8]Where several companies can operate on the same path [Malay and Keirsbilck , 2019]

liberating access by granting open access rights to all railway undertakings in the EU is a prerequisite for achieving a single market for railway transport. For the SERA, this was a necessary step to take for the European Commission. Many countries have asked that access opening be accompanied by strong safeguards to avoid compromising the economic equilibrium of public service contracts [Maczkovics , 2017]. That is part of the reason the negotiations took so long. Nevertheless, according to the Community of European Railway and Infrastructure Companies, Member States may limit the right of access to passenger services when public service contract(s) cover the same route, in cases where the economic equilibrium of the public service contract(s) would be compromised. To do so, the relevant regulatory bodies (the Regulatory Body of Railway Transport and for Brussels Airport Operation in the case of Belgium [REGUL , 2020b]), need to carry out the Economic Equilibrium Test (EET). "The economic equilibrium of a public service contract shall be considered as compromised when the proposed new rail passenger service would have a substantial negative impact on: (i) the profitability of services that the railway undertaking operates under the public service contract, and/or (ii) the net cost for the competent authority awarding the public service contract. In its analysis, the regulatory body shall refer to the public service contract as a whole, not to individual services operated under it, over its entire duration." [CER , 2018].

Secondly, the award of public contracts has also been reviewed under the PSO Regulation[9], a regulation which aims to establish the principle of competitive tendering for the award of public contracts for all means of land transport, including railways. What is to be highlighted here is that the direct award of contracts is still possible in many cases. For small contracts; for internal operators; for emergency situations; exceptional circumstances; if it can be justified by the structure and geographical characteristics of the market and network that would result in an improvement in quality of services and/or cost-efficiency; and many other restrictions. [Maczkovics , 2017]. "A parenthesis

[9]Regulation 1370/2007 [Ángel Caramello-Álvarez , 2017]

can be made about the design of Public Service Contracts and of Public Service Obligations. With the fourth Railway Package, public service obligations should, where possible, generate positive network effects, notably in terms of improved quality of services, social and territorial cohesion and/or overall efficiency of the public transport system. It is also specified that public service obligations can relate to a bundle of services amongst which some may be profitable, if combined with nonprofitable ones. That clearly allows lawful cross-subsidies to be effected within a public service contract" [Maczkovics , 2017].

Thirdly, the fourth Railway Package reinforces the independence requirements assessed in the first Railway Package concerning infrastructure managers[10] and is as prescriptive as a regulation can be. It allows little margin of discretion to the Member States in the manner they intend to organise the sector, contrary to the situation under previous EU legislation. The fourth Railway Package does not impose full institutional unbundling of railway undertakings and infrastructure managers [Maczkovics , 2017]. Indeed, a study has shown that there is no evidence that vertical separation is superior to the holding company model in its impact on rail's modal share in freight or passenger transport [Velde et al. , 2012]. Practically, the fourth Railway Package provides two layers of coordination and cooperation (between infrastructure managers and railway undertakings and between infrastructure managers themselves) that are considered as of key importance to achieve a single railway market. [Maczkovics , 2017]

For the European Commission, the fourth Railway Package "establishes the general right for railway undertakings established in one Member State to operate all types of passenger services everywhere in the EU, lays down rules aimed at improving impartiality in the governance of railway infrastructure and preventing discrimination and introduces the principle of mandatory tendering for public service contracts in rail" [European Commission , 2020]. But in practice "the market pillar focuses on questions

[10]Member States will have to ensure that the infrastructure manager has organisational and decision-making independence concerning the essential functions [Maczkovics , 2017]

of principle, such as competition and governance structures of infrastructure managers. Whereas competition and unbundling could be considered as instruments to achieve policy objectives, the Commission proposed them as objectives in themselves. As a result, the legislative process was mainly concerned by these aspects and resulted in less stringent unbundling requirements and a more progressive introduction of competition in the sector" [Maczkovics , 2017].

1.3 Ecological concerns

The railway is undoubtely the most emission-efficient mode of transportation today. The railway contributes to only 1.5 percent of the EU CO2 emissions coming from the transport sector while accounting for 8.5 percent of the market share [Ledbury et al. , 2015]. To place the data in context, 27 percent of total EU-28 greenhouse gas emissions came from the transport sector [European Environment Agency , 2019]. Thanks to electric trains powered by renewable energy, it is possible to foresee nearly carbon-free journeys and transport. But it is not only a question of CO2 emissions. Negative externalities (which are the negative effects not internalised into the price paid by the user, such as air pollution but also accidents and congestion) of the rail only accounts for 2 percent of the external cost of transport in Europe [Ledbury et al. , 2015]. With the Green New Deal that expects climate neutrality by 2050 and persuant to the EU's 2011 White Paper for Transport[11], transportation by train seems to be a reliable and factual alternative to achieving these objectives. Yet, with the constant decline of the rail transport market share in comparison with other transport mode shares [Deville and Verduyn , 2012], the objective might end up not being fulfilled even with a solution to some of the problems underneath our noses. From this perspective, this is the reason all the Railway Packages and their implementation are important. Boosting the modal share of the train sector might be beneficial not only for the travellers but for the

[11]To reduce greenhouse gas emissions from transport (including international aviation but excluding international shipping) by 2050 to a level that is 60 percent below that of 1990 [European Environment Agency , 2019].

climate as well.

2 To compete

Why competition? In the view of the European Commission, increased competition was and is seen as crucial to achieving a positive change in performance of the railway industry, supported by strengthened economic regulation and structural unbundling of key railway functions [Smith et al. , 2018]. In this respect, the next chapters will discuss the different competition practices applied and their theoretical as well as their empirical implications.

2.1 The theory of Competition

2.1.1 "Natural" Monopolies

As indicated in the first chapter, the rail sector was mainly constituted of monopolies until the 1990's. Nevertheless, even with the efforts of regulation made by the European Commission and its Railway Packages, the market does not seem perfectly competitive.

Indeed, in the words of Smith and Nash, the rail is far from being a perfectly competitive industry. In some areas, rail operators have considerable monopoly power, and it is often the case that rail prices are regulated by government. Usually, rail operators are limited in relation to their output [Smith and Nash , 2014]. Indeed, some lines are public utility and therefore not profitable and the company does not always decide at which price the tickets will be sold. For years, the rail sector has been seen as a Natural Monopoly Industry. The current definition of a Natural Monopoly is the following : *"Natural monopolies arise when the production cost associated to any set of outputs is less than the sum of the costs of producing separately all the different products in this set of outputs."* The formalised definition is this equation :
"A cost function $C(y)$ is strictly subadditive if for any vector, $y_1, ..., y_m$:

$$C\Big(\sum_{m=1}^{M} y_m\Big) < \sum_{m=1}^{M} C(y_m) \tag{1}$$

where the quantities y_m are either quantities of different outputs or different quantities of the same output". [Baumol et al. , 1977]. What is meant by that, if we take the example of rail industry, is that it is less costly for an operator to build the infrastructure, operate the trains, schedule, and manage it all than it would be for three different operators to do the tasks separately. Indeed, the regulation process started by the Railway Packages led to reform of the rail sector which had long been characterised by vertically integrated monopolies. As Crozets writes : *"A single company was responsible for all railways activities from the infrastructure for railway activities to its management, and from the organisation of transport services to their operation"* [Crozets , 2012]

The problem with monopolies is their inefficiency in terms of welfare-maximising levels of output. To simplify, since there is only one firm on the market, the price does not match the marginal cost as it would in competition and therefore, the total welfare is smaller than what it theoretically would have been with competition[12]. [Mankiw , 2018].

According to de Palma, academic scholars recognised that monopolies were unavoidable in transport networks, such as railways. [de Palma and Monardo , 2019]. But are they really unavoidable? For Léon Walras, monopolies arise because only the government can decide the expropriation of the lands required to build the transport networks [Walras , 1875]. The idea that governments are responsible for many monopolies has never really disappeared. Indeed, many monopolies we know remain unchallenged given that strong regulations often protect them. [de Palma and Monardo , 2019]

From a competition policy perspective, the role of the government is to avoid the monopolisation of the market. Yet, sometimes, the government does exactly the opposite. It restricts entry of firms into the market so that the incumbent firms enjoy market power. Usually, the reasons behind the protection of monopolies are compelling. For

[12]If these terms are not explicit for you, I can suggest the chapter 15 of Principle of economics, written by N. Gregory Mankiw [Mankiw , 2018]

example : efficiency considerations based on sunk costs, or increasing returns. Sometimes, additional entry may lead to socially wasteful duplication of certain investments, additional firm entry may be privately profitable but socially undesirable. Therefore, the government may opt for a regulated monopoly and explicitly prohibit additional firm entry. Monopolies can also be protected to enhance investment incentives in new technologies or in order to create national champions motivated by the belief that national firms lead to higher welfare than foreign ones [Belleflamme and Peitz , 2010].

Nevertheless, even in the case of railway, when the industry is vertically separated[13], the natural monopoly still exists for the infrastructure manager. But regulations can circumscribe this natural monopoly in order to limit the monopolistic behaviour that could emerge [Crozets , 2012]. And that is exactly what happened with the European Commission's Railway Packages.

2.1.2 Regulation of the European rail monopolies

Short note on regulation and deregulation.

Since the next few points will address regulation and deregulation, a short description of the two different concepts is added below. As described in the OECD glossary of Industrial Organisation Economics and Competition Law,

- *"**Regulation** is broadly defined as imposition of rules by government, backed by the use of penalties that are intended specifically to modify the economic behaviour of individuals and firms in the private sector."*
- *"**Deregulation** refers to the relaxation or removal of regulatory constraints on firms or individuals. Deregulation has become increasingly equated with promoting competition and market-oriented approaches toward pricing, output, entry and other related economic decisions".* [Khemani and Shapiro , 1993]

[13]When the Infrastructure Manager is separated from the Railways Undertakings

In the specific case of the railway market, both concepts are used to promote competition. A simple example to assist in a better understanding : the governments **regulate** the rail industry by vertically separating the infrastructures managers and the operators; and the governments **deregulate** the rail industry by allowing open access. Both of these actions decidedly aim towards a more competitive market and industry.
Let's now understand the reasons behind these *(de)*regulations.

Vertical Separation The aim of vertically separating national railway was to change the organisation and internal operating rules of the railway system. Indeed, these rules used to generate a high degree of inertia in Europe. Since the reform aimed at developing competition, the Infrastructure Managers[14] (IM) have a new role. Being now considered as circumscribed monopolies, they should conform to 2 main ideas :

- First, the railway sector should be open to competition when possible;
- Second, the IM should now be monitored and regulated by regulatory bodies. [Crozets , 2012]

For Smith et al. , 2018, the presence of an independent regulator is also important even if some studies emphasise the potentially harmful effects of excessive or misguided regulation (which underlines the importance of ensuring the minimisation of unnecessary or even destructive regulation) [Smith et al. , 2018]. In the mean time, Wetzel , 2008, associates independent regulation with lower costs while Friebel et al. , 2010, find similar benefits. Eventually, it would not only be a question of vertical separation or not but also of the potentially positive impacts of stronger and clearer regulatory powers to promote competition, quality, and efficiency of European railways by giving the powers to the independent regulators to challenge the IM on their efficiency performance. However, this has been proved to be difficult in railways due to the lack of powers of efficiency determination [Smith and Nash , 2014; Smith et al. , 2018].

In the view of the complexity of the powers Smith et al. , 2018 computed a table of the

[14]Infrabel in Belgium

ideal rail regulator characteristics, that you can find in appendix A. Main characteristics are the independence, non-discrimination towards operators, transparency and cost-effectiveness. It is thought that there was not a totally clear cut expectation on the impact of stronger and more independent regulation on rail system costs, although it was expected to bring about a reduction in costs. However, regulation and its consequences were thought surely to be closely interrelated with the structural setting and the degree of competition [Smith et al. , 2018]

Horizontal Separation is the scenario of separating the freight and the passenger market. Yet, since the focus here is mainly on the passenger market under competition, this topic will not be extensively discussed. Few reforms to the horizontal dimension have been observed. Indeed, new entrants are a big part of the reform, but the simple separation of freight and passenger service have not been a huge area of debate. [Cantos et al. , 2010]. The next sections will talk more extensively about new entrants.

2.1.3 Competition *in* the market : Open Access

The separation of the management and ownership of the network infrastructure and the operation of services, explored in the previous section, is seen as the starting point and enabler of open access competition [Feuerstein et al. , 2018]. But a lot of other factors also influence open access competition.

First, the fee to be paid in order to operate on a certain infrastructure. As assessed in their book, for Finger and Messulam , 2015, costs or rail access charges ("RACs") account for a big share of railway undertaking's ("RU") operational costs, ca. 25–30 percent [Finger and Messulam , 2015]. Therefore, a lot of researchers agree that the fixing of the RACs play a big role for the existence of open access competition. But they are complex and it has been argued that optimal pricing of rail infrastructure will increase competition. In turn more competition subsequently results in a reduction in RACs from which the customers can profit. [Feuerstein et al. , 2018]. So finding and

applying the optimal RAC seems crucial.

Second, still according to Finger and Messulam , 2015, rolling stock is one of a RU's largest recurring expense items, at round about 20–30 percent of its fixed costs [Finger and Messulam , 2015]. New railway rolling stock requires large-scale as well as long-term investments which lead to a high risk for new entrants [Nilsson et al. , 2013]. The acquisition of cheaper second-hand rolling stock is not easy in most EU countries, since only a small market could be established up till now. Therefore, despite free access to first-hand rolling stock and the potential access to second-hand, the high investment sum needed for rolling stock acts effectively as an entry barrier for the Open Access Operators (OAO). Finally, the influence of intermodal competition, namely in regard to airlines, state that this competition has altered the price perception of consumers, making them more price-sensitive, which affects the rail productivity [Feuerstein et al. , 2018]. All these factors impact open-access competition and operators.

A recent theoretical study by Broman and Eliasson , 2019, focused on how open access competition affects fares, demand, supply, consumer surplus and operator profits compared to a monopoly profits and to a welfare-maximising benchmark. Their theoretical model shows that going from a monopoly to open access competition tends to increase social welfare substantially, reducing profits and benefiting travellers. The total welfare computed in the duopoly situation is close to the ideal, hypothetical case with a welfare-maximising operator under a cost recovery constraint. They suggest that a welfare-maximising infrastructure agency should arrange operators' departures so that they are intermingled, in order to increase price competition. They found that operators in duopoly will not offer equally many departures in equilibrium and that it lowers total welfare compared to symmetry. They conclude that open access competition has the potential to increase overall welfare by reducing the deadweight losses[15] stemming from monopoly situations. Their simulation model demonstrates that there

[15]Again, if these terms are not explicit for you, I still suggest the chapter 15 of Principle of economics, written by N. Gregory Mankiw [Mankiw , 2018]

exists a stable equilibrium between two operators, where both operators make positive profits. [Broman and Eliasson , 2019]

2.1.4 Competition *for* the market : Competitive tendering with Public Service Contracts

Public service contracts (PSC), acting as regulated competition involves competition on the tracks, through contracted services. PSC are applicable to services which require a contractual basis with a public authority due to the involvement of public service obligations (PSO). This model allows for the development of competition between operators. Indeed PSC will be subject to compulsory tendering pursuant to the model of competition for the market [Ángel Caramello-Álvarez , 2017]. The principle behind competitive tendering through PSC is the fact that countries will have to choose between multiple operators to operate on a certain route. If multiple operators apply, competition is supposed to rise (assuming there is no collusion), pushing prices downwards and quality upwards the same way competition works on other markets. Yet, it is important that countries play by the rules. This is because tendering procedures will not be successful if it is widespread knowledge that the awarding authority does not respect its financial obligations or is not able to provide adequate funding [Ángel Caramello-Álvarez , 2017].

Let's keep in mind that all the previous concepts derive from theory. And that economic theory generally predicts that increases in competition will lead to improved services and lower costs [Nash et al. , 2011].
The theory of competition in the railway industry predicts here that vertical separation decreases cost [Wetzel , 2008; Friebel et al. , 2010] along with enabling competition between operators [Feuerstein et al. , 2018]; that the presence of an independent regulator is important and is expected to reduce costs [Smith et al. , 2018]; that Open Access competition has the potential to increase overall welfare with two profit-making firms [Broman and Eliasson , 2019], and finally that competitive tendering through PSC will

allow for competition between operators [Ángel Caramello-Álvarez , 2017]. We will observe, in the next section, that the empirical studies provided results that did not always adhere to theoretical previsions.

2.2 Empirical results of competition implementation

Since 1990 and the first wave of liberalisation started by Britain, the effect of restructuring the rail market has been extensively written about. You can find in the next sections a summary of the empirical results on the topic.

2.2.1 Horizontal and Vertical Separation

Vertical Separation. A number of econometric studies of railway industry costs have been conducted over the years. No consensus has been reached on whether vertical separation is necessary or sufficient to deliver competition according to the theoretical prediction [Nash et al. , 2011]. In the next table you can find a summary of the previous econometric studies and results.

Author(s), Year	Countries	Effects
Mizutani and Shoji , 2004	Japan	No impact compared to integration
Jensen and Stelling , 2007	Sweden	Negative
Wetzel , 2008	Europe	Not significant
Growitsch and Wetzel , 2008	Europe	Not Significant
Friebel et al. , 2010	Europe	Positive if appropriately phased
Cantos et al. , 2010	Europe	Positive
Cantos-Sánchez et al. , 2012	Europe	Not significant
Mizutani and Uranishi , 2012	OECD	Depends on train density
Velde et al. , 2012	Europe	Increases 20 percent total rail system costs
Mizutani et al. , 2015*	OECD	**Depends on intensity of traffic**

Table 1: Impact of vertical separation on costs. This table is my own elaboration based on and inspired by [Gutierrez-Hita and Ruiz-Rua , 2019], [Nash et al. , 2011].

***To elaborate** : the main results of Mizutani et al. , 2015 are the following : A holding company model reduces cost compared to vertical integration, but the effect is small

and does not vary as the train density changes. Inversely, the effect of a full vertical separation depends on the usage intensity. The more dense the traffic, the more vertical separation is costly. [Mizutani et al. , 2015]

Before the study of Mizutani et al. , 2015, the econometric studies only focused on vertical separation or vertical integration. What they did was to add an intermediate level of separation : the holding company model[16] [Mizutani et al. , 2015]. By adding this intermediary position, they paved the way towards the importance of a possible external regulator, needed in vertical integration but also in the holding company model, in order to avoid conflicts of interest. The role of the regulator is discussed in the next section.

Horizontal Separation. For Smith and Nash , 2014, horizontal separation of freight and passenger undertakings seems to have sharply reduced costs. Yet, they suppose that this has typically been associated with preparation of the freight undertaking for privatisation [Smith and Nash , 2014]. The literature on the subject has arrived at a consensus, they all agree that vertical separation reduces cost. Indeed, for Velde et al. , 2012 horizontal separation appears to have led to a very substantial reduction in costs. For them the reason behind this is perhaps because such separation has usually been associated in Europe with selling off the freight operations, and has therefore imposed strong pressure to reduce costs [Velde et al. , 2012].

2.2.2 Regulators and their power

One of the most recent studies on this subject has been conducted by Smith et al. , 2018. Their paper studies the impact of the vertical separation on the efficiency levels of a panel of 17 European railways (2002-2010). They incorporated a multidimensional rail regulation index to assess the many differences of European regulation application into an econometric framework alongside other reform variables (in some econometric

[16] *A holding company is when a company controls another company. The controlling firm is the holding one, and must own more than 50 per cent of the common shares*[Khemani and Shapiro , 1993].

regressions, they add competition dummies). Previous studies did not include the impact of the multiple activities and complex remits of rail regulatory bodies in Europe. [Smith et al. , 2018] For their case with two outputs (passenger train km and freight train km, together with output hedonic[17] characteristic variables), the one they favour for numerous factors[18], their findings on the impact of vertical separation and vertical integration (relative to the holding company model) confirm the results found in Mizutani et al. , 2015; that it depends on traffic intensity, See 1. They also show that strong economic regulation reduces costs, but the precise mechanism by which this is achieved, and how it relates to other reforms, depends on the output / hedonic specification. Nevertheless, around the sample means of traffic, vertical structure does not seem to have much impact. However, as the network becomes more intensely used, vertical separation starts to increase costs relative to the holding company model (whereas for more lightly used systems, vertical separation reduces costs relative to the holding model). For them, this is important from a European policy perspective, providing further confirmation of the finding of a link between the impact of vertical separation and traffic density.

They graphically represent their findings as follows :

They conclude that the results suggest that the cost-reducing benefits of regulatory reform depend on the degree (actual or desired) of market openness, vertical structure, and the intensity of network usage [Smith et al. , 2018]. For Mizutani et al. , 2015, the cost of imposing vertical separation, where it is not already in place, would increase EU-wide rail costs by around 6 billion euros per year, with this cost likely to be higher in future years if the Commission's ambitious growth targets for rail are achieved. The clear policy conclusion from these works is that a one-size-fits-all policy is not appropriate. [Mizutani et al. , 2015; Smith et al. , 2018]

[17] *Connected with feelings of pleasure* so we can understand it by consumer satisfaction

[18] They consider that this approach enriches the specification to reflect the fact that costs will be driven by output characteristics (such as trip length) as well as outputs (disaggregate passenger and freight measures) [Smith et al. , 2018].

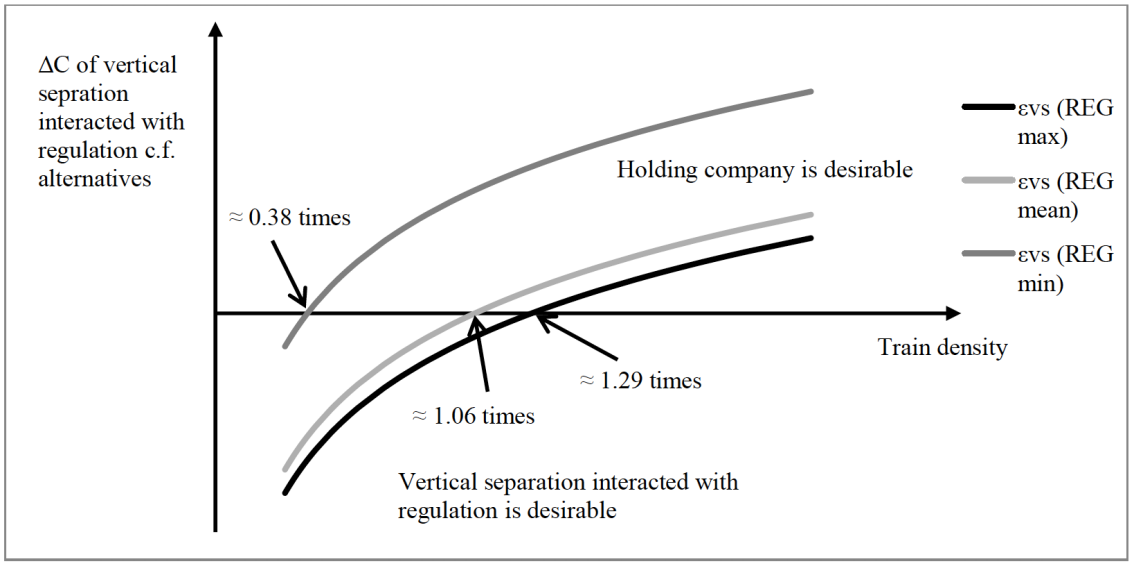

Figure 1: Source : [Smith et al. , 2018]. Cost Difference between Vertical Separation Interacted with Minimum, Mean and Maximum Levels of Regulation and Holding Company, and their Relationship with Train Density

As we can observe, the results are a bit contradictory but above all, they do not seem to conclude that introducing competition by totally separating the infrastructure managers (IM) from the operators - which is the preferred and suggested way of the European Commission - is the proper method of proceeding. What is derived from the literature is that the key to the solution lies in the context in which the vertical separation takes place, and that every country should be able to choose which reform fits their market the best.

2.2.3 Open-Access

The literature on Open Access Operators (OAO) in passenger services is limited by the small size of the market. [Wheat et al. , 2018]. A notable exception is represented by OAOs First Hull Trains and Grand Central, competing with the incumbent on the East Coast Main Line in Great Britain. The British case has been analysed by the Competition and Markets Authority (CMA), which has found overwhelming evidence of downward pressure on fares and upward pressure on service and innovation arising from open access competition. The evidence on the industry-wide efficiency impacts of OAOs

is more mixed [Casullo , 2016]. Potential other evidences that could have been looked at is cross-border operators competing with domestic operators. But international services have much lower frequencies and have not yet targeted domestic passenger markets [Bergantino et al. , 2015], which means they do not compete for the same market and therefore do not compete with each other. The preliminary results of Casullo , 2016, on domestic passenger services, found that "using a difference-in-difference estimator, two years of on-track competition following open access entry do not show operational efficiencies in the rail markets affected (Austria, the Czech Republic and Italy) when compared to a group of similar rail networks. On the contrary, it appears that on-track competition results in higher unit costs than in countries with monopoly passenger services. Higher unit costs may be the result of negative efficiency impacts (loss of economies of density, duplication of large upfront investment costs, higher coordination costs) outweighing the positive efficiency impacts witnessed in other liberalised sectors" [Casullo , 2016]. On the contrary the study by Feuerstein et al. , 2018, focused on long distance passenger transport, shows that open access competition is overall perceived to have a positive effect on long-distance passenger rail. For them, open access is a tool which promotes increased efficiency, modernises passenger rail, establishes a higher customer focus, and decreases overall transport emissions. [Feuerstein et al. , 2018]

2.2.4 Coexistence of competition *for* and *in* the market

A recent study by Wheat et al. , 2018, focuses on what is the best way to open up passenger rail markets to increased competition and specifically, whether to allow open access to train operators (OAO) alongside tendered PSO operators (called FIO for Franchised Intercity Operators in their study). This was a big question and concern addressed during the negotiations in the light of the fourth Railway Package [Maczkovics , 2017]. What their empirical work showed is that the actual costs per train hour or per vehicle hour of OAO Train Operating Companies (TOCs) are not found to be greater than FIO TOCs even if their findings on substantial returns to density in the industry which should penalise OAO operators differs considerably [Wheat et al. , 2018]. In

short, they find that open access competition is not more expensive than traditional contracts.

They rationalise that part of the reason for little actual difference is due to OAO facing statistically significantly lower input prices. Indeed, it appears that OAOs are 34 percent cheaper than FIOs, over and above savings from input prices. They conclude that competition in the market and for the market can co-exist without major cost disadvantages in the passenger train operations sector relative to the current structure (where countries don't want Open access and competitive tendering at the same time) [Wheat et al. , 2018] .

2.3 Conclusion on competition

The theory of competition in the rail market seems to imply that its implementation is going to magically solve all the problems inherent to the "current" monopoly model. However, the empirical studies often tell another story. Some studies report only positives outcomes of competition : Feuerstein et al. , 2018 with positive impact of open access competition on long-distance passengers trains and Wheat et al. , 2018 which finds that open access operators does not cost more than traditional operators. Nevertheless, numerous authors in recent years Mizutani et al. , 2015, Smith et al. , 2018, and others declare that there is no single outcome applicable to every country. The situation depends on numerous of factors and it would be an economical nonsense to ask every government to apply the exact same reform. And finally, for some authors like Velde et al. , 2012, Casullo , 2016, competition in the train sector simply raises the costs compared to monopolies and is not a direction to pursue.

So what can be understood and concluded from this review of literature? One of the biggest criticisms that can be aimed at these studies is the unreliability of the data sets. In former studies (before [Mizutani et al. , 2015]) some data were missing, as the researchers used raw UIC[19] data, which were often outdated. Another problem of the

[19]The worldwide railway organisation, also known as Union Internationale des Chemins de fer.

data is the lack thereof. Very few countries have really applied open access competition until now, which is why the results are as yet unclear [Wheat et al. , 2018]. There is a relatively small sample of countries and there are significant differences in the way in which reform has been carried out amongst them. Furthermore, only few countries have seen significant levels of competition, particularly in the passenger market. There are also serious problems in ensuring that data are comparable [Nash et al. , 2011].

Another reason for the divergence might, in my opinion, come from the highly political aspect of these reforms. The rail industry accounts for 0,6 percent of the total working population in Belgium, with more than 35,000 employees in 2015. [Michas , 2019; IFC , 2016]. In such sensitive topics, researchers might be influenced, not only by the country they come from but also by who sponsored or asked for the analysis, at least with respect to the outcome they sought.

3 Or not to compete ?

3.1 Switzerland and the "refusal" of competition

Improving performance or efficiency on railway does not always have to go hand in hand with actual competition. Indeed, after Switzerland reformed its passenger transport (from 1996 to 2005), performance seemed to have improved, and without any perceptible competition. The Swiss railway reform resulted in the “Swiss model” that differs from the standards being promoted by the European Commission based on market liberalisation and competition between operators. Institutionally it has its own specificity and is more akin to a particular type of governance implicating public authorities, rail companies (and public transport companies more broadly) and travellers, than to a true change in its market structure, based on more open competition. [Desmaris , 2014]

Indeed, it implemented “net cost” contracts[20]. It also transferred the powers to canton authorities and held the cantons entirely responsible for organising regional commuter services in their respective territories. Finally, the Swiss railway architecture is similar to a “hybrid” system between liberalisation and integration [Finger and Holterman , 2013; Maier-Gyomlay , 2013]. It is vertically integrated (and this integration is often put forward as an essential condition of its exceptional performance) yet the principle of competition is accepted while never observed till today. So this hybrid model is only partly in accordance with Community law and its philosophy [Desmaris , 2014].

The reform resulted in more efficient use of public funds for each train-kilometre provided (the Swiss government paid CHF 10.2 in 2000, and only CHF 7.6 in 2006, with a slight increase since 2010 (CHF 7.8 in 2013)). Since then, public subsidies have slightly

[20] *"When public authorities only pay for services agreed upon in advance (for a given route, for an established duration, providing for specific services) and only pay the amount clearly stated in the contract. The amount of any financial compensation corresponds solely to the running loss projected by the operator period initially. This type of contract incites the commissioned operator to both reduce costs and increase income, as any losses will not be covered ex post."* [Desmaris , 2014]

increased but despite higher subsidies, the level of cost coverage has increased only slightly by an average of 0.6 percent per year since 2012 thanks to a rise in profitability and demand. [Stückelberger et al. , 2017]. Other outcomes of the reform are the higher quality services for rail passenger service frequency (which is the highest in the world), with over 130 trains daily per line, and train punctuality that is stable with exceptionally high rates, with essentially 90.1 percent of trains arriving on time in 2018 [Swiss Travel System , 2020; Desmaris , 2014].

The results obtained, namely increased efficiency and effectiveness in the use of public funds and strengthening the modal share of the railway, are due, for the most part, to the nature of public governance and its impact on the behavior of all stakeholders. The imposed "performance constraints" on the incumbent railway operator seems to be a key element in explaining the positive outcomes of the reform. While competition in and for the market is apparently lacking, there is still some kind of competition happening. Indeed, with 12 railway undertakings supplying PSO services on the network, all vertically integrated, the authorities managed to create a benchmark and maintain healthy rivalry between the networks, which allows a competition by "comparison" [Desmaris , 2014 ; Ángel Caramello-Álvarez , 2017]

3.2 Investments

The link between investment and performance does not need to be proven. One way to change efficiency, much favoured by traditional, engineering-dominated railway managements, is increased investment by increasing capital intensity (in an already highly intensive capital industry) [Thompson and Bente , 2014]. For Duranton et al. , 2017, higher public costs (the sum of public subsidies and investment including the cost of debt and expected future investments) correlates with performance improvement. Even if they could only find correlation, they assesed that it applied over time as well. Countries that increased their public cost (that invested more in their railways) have seen an higher increase in performance [Duranton et al. , 2017]. Indeed, it is important to

acknowledge the role of investment at improving efficiency when a good financial or economic case can be made, especially when the success of a new structure depends on a fresh start from years of past investment neglect [Thompson and Bente , 2014]. Yet, investment even if necessary does not answer the entire question when capital is limited or reduced, an outcome we can expect from the ongoing Covid-19 crisis/pandemic.

3.3 Structure, Ownership and Incentives

3.3.1 Structure and Ownership

Besides investments, Thompson and Bente , 2014 identify 3 ways in which efficiency can be changed : Structure, Ownership and Incentives. Structural and ownership changes, explained in depth in the last chapter, concern the type of separation of the structure, whether vertically integrated or not. Ownership, can be understood as the level of liberalisation of the sector.

3.3.2 Incentives

Described as "the rules of the game", where operators enjoy more freedom to operate and achieve objectives that include risk of cost control or net revenue maximising incentives, these have not been in the spotlight yet. [Thompson and Bente , 2014] When we think about the improving mechanisms of Switzerland through their Public Services Requirement, it seems logical to try to understand whether these incentives are a real asset in the search for performance in the railway sector and how it should be implemented.

Indeed, the incentives in Europe are generally not the best. Currently, a lot of PSO undertaking in Europe (specifically EU-13) face under-compensation[21]. In Eastern European countries, only 64.5 percent, on average, of the net costs incurred for

[21] *Public service obligations are to be compensated either through direct financial input, including a reasonable profit and/or through the award of exclusive rights. In practice it appears that most operators benefit from financial compensations*[Ángel Caramello-Álvarez , 2017]

the discharge of the PSO was covered by the compensation granted in 2015 [Ángel Caramello-Álvarez , 2017]. In Belgium, the apparent proportion of PSO costs covered from passenger fares does not reach 40 percent, even if between 2011 and 2014, PSO compensation increased in absolute terms. [European Commission , 2016 and European Commission , 2019]. The problem, with under-compensation of PSO, is that the degree of deficit inevitably leads passenger rail companies into a downward spiral of financial losses and reduced competitiveness, thus forcing them into short-term borrowings. There are many linked issues induced by this under-compensation. Implicit obligations not explicitly required by public authorities, compensation through commercial revenues from freight and cross-subsidies affecting freight viability, quality implications caused by the low availability of rolling stock, modal shift to less environmental friendly transport modes and lack of competitiveness, all form a large yet non-exhaustive list. As a result, the analysis of the CER - The Voice of European railways states that *"the main objective envisaged in the Fourth Railway Package – i.e. the opening of the domestic passenger traffic through the wide application of open access rules and public tendering procedures – has very few chances of being accomplished, without first resolving the issue of under-compensation in a pragmatic way."* [Ángel Caramello-Álvarez , 2017].

4 How to measure performance

4.1 How is it usually measured?

Assessing performance is not an easy task. Many indicators can seem to assess performance properly but are not comprehensive. Railways produce a wide range of outputs including passenger services, freight services and, sometimes, separated infrastructure access services. Even if the railway data sets are probably way more detailed than in other modes of transportation, they have multiple issues concerning quality, quantity, consistency and cost [Thompson and Bente , 2014]. For Thompson and Bente , 2014, the complexity of measuring performance comes from the differences in size and scale, differences in mix of services, the number of different type of indices and the importance of cross section[22] and time series[23]. Good examples of simple indicators we can think of are Passenger and Freight data with Passenger-kilometers indicator and Tonnes carried; Punctuality and Safety data with the ratio of delayed trains, the number of accidents and fatalities, etc. Another driver of performance at least compared to other modes of transportation is the modal part. The modal part computes the "market share" of trains in the train-bus-car transportation market [Malay and Keirsbilck , 2019]. In an attempt to understand the nature and performance of the performance of railways among Member States, Steer Davies Gleave, at the behest of European Commission Directorate General for Mobility and Transport, collected data sets for 32 indicators across 26 Member States. And even with their analysis, the data still encountered limitations and gaps [Steer Davies Gleave , 2015]

[22] Comparing railway systems at a single point in time [Thompson and Bente , 2014]
[23] Change over time [Thompson and Bente , 2014]

4.2 BCG performance index

4.2.1 General facts about the index

Since 2012, in the view of the complexity of this measurement, The Boston Consulting Group (BCG) developed the *European Railway Performance Index* (RPI), as a comprehensive index to provide insight in order to help different operators improve their performance. They published 3 different reports, in 2012 [Duranton et al. , 2012], 2015 [Duranton et al. , 2015] and 2017 [Duranton et al. , 2017]. This indicator solved the main problem of cross section and time series data, and relies on three dimensions of the Railway System Performance as follows :

1. Intensity of use : "*To what extent is rail transport used by passengers and freight companies*" ;
2. Quality of Service : "*Are trains punctual and fast, and is rail travel affordable*" ;
3. Safety : "*Does the railway system adhere to the highest safety standards?*". [Duranton et al. , 2017]

The three dimensions are taken into account at the same level in order to compute the RPI. You can find all all the different factors and indicators in the table below. It is still important to realise that even if this indicator tries to be the most comprehensive, it does not describe the entire picture. Some indicators are missing : labour force, revenues, size of the company, etc. Another setback is the fact that the BCG analysis is not entirely clear when it comes to the data nor methodology used. In addition, main biases of the indicator are the following

1. "*Passenger performance is over-weighted relative to freight performance because reliable information about quality of service of freight operators is unavailable.*" ;
2. "*Large countries are favoured relative to smaller countries because the quality-of-service dimension takes into account the share of high-speed-rail travelers*" ;

3. "*Countries in which consumers have low purchasing power are favoured relative to those in which purchasing power is higher, average fares are not adjusted on the basis of Purchasing Power Parity (PPP)*". [Duranton et al. , 2017]

Yet, in order to complete their observation, the BCG study compares the ratings obtained by their RPI and the level of Public cost incurred by the railway sector to the country [Duranton et al. , 2015]. This is rarely done when comparing Rail Sector Performance, so it is a huge advantage of their analysis.

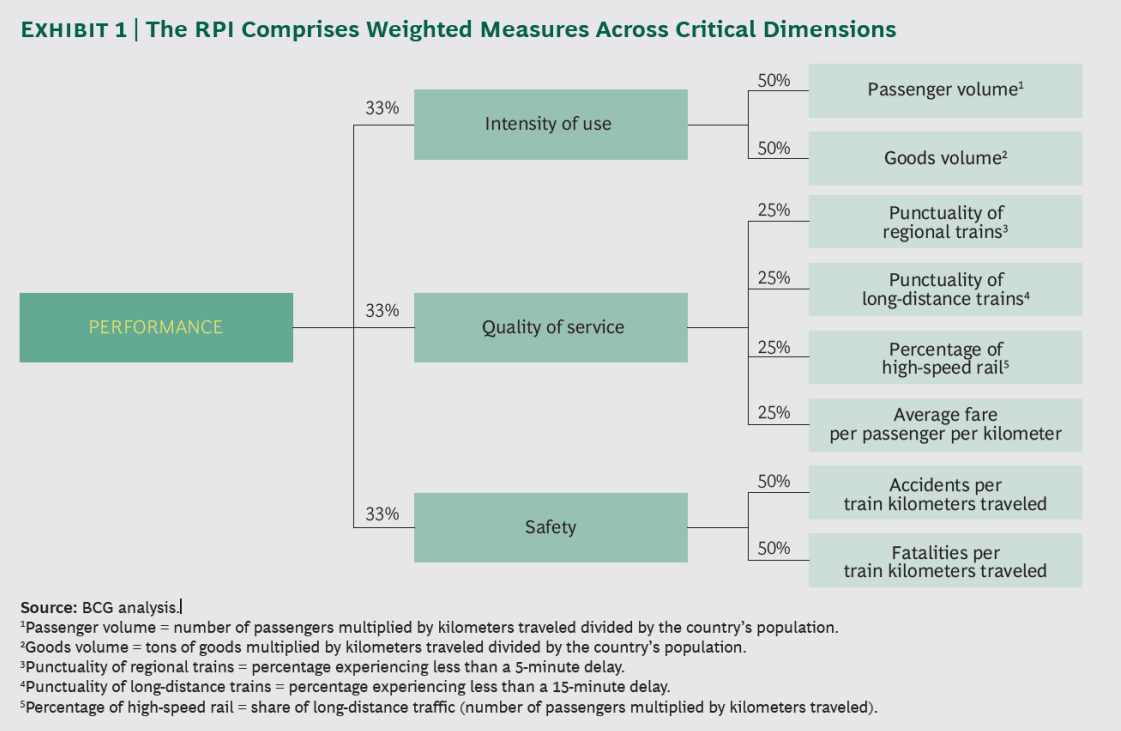

Figure 2: [Duranton et al. , 2017] : BCG Analysis

For all the preceding reasons, and the sake of clarity, this thesis will use the BCG European Railway Performance Index as a basis in order to measure performance.

4.2.2 Description of the three dimensions

Intensity of use : In order to measure the intensity of use, the BCG analysis uses two indicators, both valued at 50 percent.

- First, the passenger volume, which is the number of passengers multiplied by kilometers traveled divided by the country population.
- Second, the goods volume, represented by the tons of good multiplied by kilometers traveled divided by the country's population [Duranton et al. , 2017].

Both indicators are a variant to the classical indicators provided by the UIC, available for most European countries.

Quality of service : The measure of the quality of services consists of four different indicators, all valued at 25 percent for the Quality score.

- The punctuality of regional trains, is an unchanged indicator easily available on the Infrabel Open-data website[24] for Belgium.
- The punctuality of long-distance trains, as for regional trains (that can be considered as all trains in Belgium), we can find this data set on the infrabel website[25], they just need to be regrouped.
- Percentage of high-speed rail which is the share of long-distance traffic (number of passengers multiplied by kilometers traveled).
- Average fare per kilometer. For this indicator, BCG does not explain their process to obtain the average fare. [Duranton et al. , 2017]

However, for some of the previous indicators, BCG seems to have accessed a "non-public" part of the UIC data sets.

Safety : Concerning the way it measures safety, only two factors are taken into consideration.

- Accidents per train kilometer traveled, where the total number of accidents is available on the UIC database.

[24]https://opendata.infrabel.be/explore/dataset/nationale-stiptheid-per-maand/information/
[25]https://opendata.infrabel.be/explore/dataset/stiptheid-tgv/information/

- Fatalities per train kilometer traveled. [Duranton et al. , 2017]

According to The Safety Directive 2004/49/EC concerning the safety data, the Common Safety Indicators (CSI) emerged with the second Railway Package. They have comprehensive data on many safety indicators and they compel Member States to apply the same definition since 2010. [European Union Agency for Railways , 2020]

The results of the BCG analysis, with the countries RPI are displayed in the following chart.

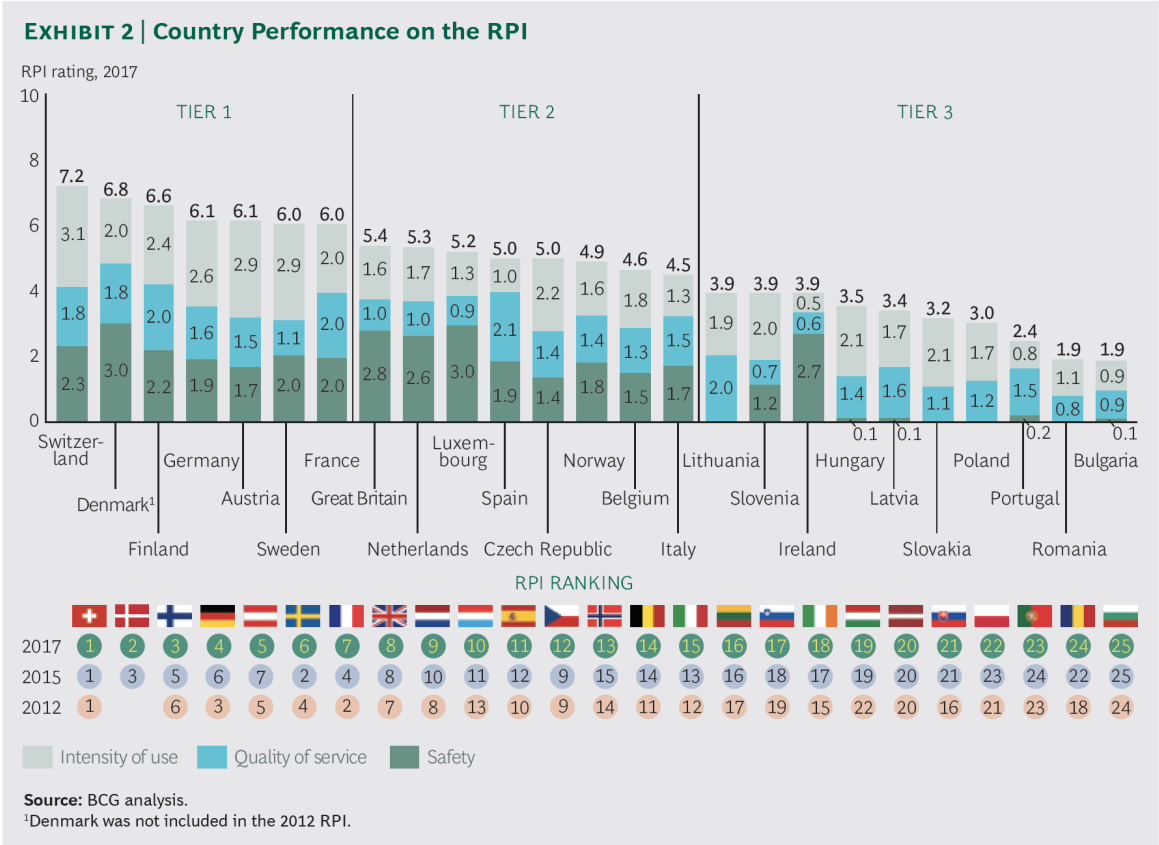

Figure 3: [Duranton et al. , 2017] : BCG Ranking

Part III

Analysis

5 The Rail Sector

5.1 Belgium

The Belgian railway network comprises 3,607 kilometres of railway lines and is one of the densest rail networks in the world on a national level. The network is primarily used for passenger transport. In 2018, passenger trains accounted for 86.9 percent of train kilometres. [REGUL , 2019b].

But how are the Railway Packages implemented in Belgium? For the Regulatory Body for Railway Transport and for Brussels Airport Operation, the passenger transport in Belgium is completely liberalised since the 1st January 2019 [REGUL , 2020b]. But what does this really means?

5.1.1 Vertical separation

Since the first Railway Package, Member States have to ensure that the infrastructure manager has organisational and decision-making independence concerning the essential functions and this issue was again clarified in the fourth Railway Package, even if the full unbundling is not imposed although highly recommended [Maczkovics , 2017]. The Regulatory Body (RB) for Railway Transport in Belgium is in responsible for offering advice, monitoring (including specific investigations) and resolving conflicts (whether it is disputes or complaints) [REGUL , 2020b].

In 2019, the RB for Railway transport issued the decision D-2019-02-SC relative to the organisational and decision-making separation within the SNCB[26]. In the investigation report, the Regulatory Body found that SNCB has favourably fulfilled several criteria and indicators relating to decision-making and organisational independence. However, some remarks were made by the Regulatory Body requiring clarification or adaptation on the part of SNCB. The findings are summarised in Appendix B (only French version available). For the Regulatory Body, numerous areas required modification.

Concerning decision-making independence, the budget setting, the payment of royalties, the conditions of access and investment autonomy, all need modification. Concerning organisational independence, the confidentiality content, the appointment and dismissal conditions, the accumulation of functions as well as the website needed to be reviewed to ensure the organisational and decision-making independence of the SNCB [Serge Drugmand , 2019].

Finally, it concluded that, within the current situation, SNCB meets the requirements of transparency, independence and non-discrimination in the light of Article 9§3 of the Rail Code when dealing with access to service installations but that it will be subject to regular monitoring [Serge Drugmand , 2019].

The ownership of SNCB also faced some changes recently. Yet, the "new entrants" in ownership are not independent organisations. They have various links to domestic and foreign historical operators. In 2019, only 5 percent of the market was actually owned by private companies (in shares). One foreign historical operator held 34 percent of the market, while the Belgian historical operator still held 61 percent of the market. Nevertheless, this is an improvement, from 2014, when the Belgian share amounted to 90 percent. [REGUL , 2020a]

[26]For Société nationale des chemins de fer belges, the historical operator in Belgium.

5.1.2 Public Services Contracts and Open Access

In 2019, there was only competition on the international passenger market (new entrants[27] held almost 60 percent of the market in train kilometres), but none in the national passenger market. The national passenger transport in Belgium is entirely provided by the historical operator, the SNCB/NMBS. Thus, the share in total passenger transport is very high (more than 90 percent) compared to the rest of Europe (around 70 percent) [REGUL , 2020a]. Indeed, the entire network of Belgian railways will be available to open access competition in December 2020. 25 December 2023 is the 2nd key date set throughout Europe. For the public service mission which is the one assigned to the SNCB, the competitive bidding process will be the rule as of 25 December, 2023. Until that date, the State may decide to allocate directly this mission to the SNCB for a maximum period of 10 years [Durt et al. , 2020].

Since there is no competition at the moment in the national rail market, no conclusion can be made regarding how competition works in Belgium. Yet, in order to prevent too much pressure on the incumbent operator, all the measures concerning the Economic Equilibrium Test are known and detailed in the next section.

5.1.3 Economic Equilibrium Test

Belgium applies the EET (Economic Equilibrium Test) as foreseen by European Legislation[28]. The test, which is an impact evaluation method consists of two elements.

First, an economic analysis that takes into account the entity asking for this analysis. Whether it is requested by the Railway Undertaking (RU) operating the public service contract, the competent authority which awarded the management contract or the Infrastructure Manager (IM); it is organised in two phases. During the first phase, an impact analysis is carried out on the expected turnover, including a study of the potential influence on revenue related to domestic passenger transport and on subsidies.

[27]Not the incumbent national operator, SNCB/NMBS.
[28]Implementing Act 2018/1795

In a second phase, an analysis of the profitability ratio is carried out in accordance with the rules of cost accounting. In this way, it will become possible to obtain, from the cost accounting perspective, a clear picture of the possible economic impact of the new service on the management contracts that have been concluded [REGUL , 2019a].

Second, an impact analysis that examines the effects of the new relationship on the overall supply of transport services. In this impact analysis the following elements will be considered:
a) the potential net benefits that the new rail passenger service will bring to customers in the short and medium term ;
(b) the potential impact of the new rail passenger service on the performance and quality of rail transport services ;
(c) the potential impact of the new rail passenger service on the development of the timetable for rail transport services.

If there are indications of a significant impact (positive or negative) on the passenger transport sector, these consequences will be examined in a cost-benefit analysis which will attempt to set a value for the observed effects [REGUL , 2019a].

5.1.4 Other facts and figures

Charges of the Infrastructure manager. In 2018, infrastructure charge covered approximately 54 percent of the operating costs. It costs approximately 8.5 EUR per train kilometre for national and 10.6 EUR per train kilometre for international passenger transport [REGUL , 2020a].

Investment of Infrabel Infrabel continues to invest decreasingly each year in rail, both for passenger transport and freight transport. The largest expense has been capacity maintenance for several years [REGUL , 2020a]. The SNCB invested 604,6 million [€] in 2019 [Durt et al. , 2020]

5.1.5 Overview

From a regulatory and legal perspective, Belgium appears to be ready to open the national passenger rail to competition. Yet, Axel Gauthier's calculations and those of the SNCB tend to show that neither the quality of service nor the productivity of the company is satisfactory in order to achieve performance comparable to that of others European companies[Gauthier and Salem , 2016].

Furthermore, the measures taken, with the EET for example, seem to indicate that the country does not welcome the liberalisation process with open arms. Another important factor to emphasise is the opposition of the SNCB CEO, Sophie Dutordoir, to the liberalisation process. She thinks "*it's an aberration to liberalise the Belgian railway world. In [her] view, public service must be kept consolidated in one hand with all the control mechanisms that are obviously needed. We are not going to start cutting the public service into four or ten. It would not be anybody's idea to liberalise and divide the Department of Finance or the Department of Justice*" [Everaert , 2019].

All these factors seem to converge towards a complicated future (both on a short and long-term basis) for liberalisation in Belgium.

5.2 Other Countries

When analysing which countries were comparable to Belgium in terms of geographic and demographic characteristics, I reached the same conclusions as Gauthier and Salem , 2016. Belgium, The Netherlands, Switzerland, Denmark and to a lesser extent Austria present similar characteristics [Gauthier and Salem , 2016]. You will find a summary description of the different structural and relevant factors in the next sections. The 4 other countries substantially outperform Belgium at the RPI ranking [Duranton et al. , 2017].

5.2.1 Demographic, geographic and general observations

Country	Belgium	Netherlands	Switzerland	Denmark	Austria
Demographic data					
Surface Area [km^2]	30.689	41.543	41.285	42.933	83.879
Population	11.549.888	17.407.585	8.606.033	5.822.763	8.901.064
GDP/capita [€]	35.900	41.870	59.970	49.180	38.250
Railway data					
Network length [km]	3607	3058	5304	2539	4917
Mpkm	10.025	17.095*	20.010	6.332	12.579
Passengers Ratio	0,867	0,982*	2,320	1,087	1,413
Revenue [€]	8	NA	NA	19	16
Punctuality [%]	88	95,25	90,15*	97	96,75
Accidents	28,6	28,3	42,3	7	48,6
Accidents Ratio [%]	0,285 (350,52)	0,165* (604,06)	0,211 (473,04)	0,110 (904,57)	0,386 (258,82)

Table 2: General characteristics of BE, NL, CH, DK and AT rail sector. Own elaboration with source from : [EU Open Data Portal , 2018; Eurostat , 2020a; Eurostat , 2020b; Stückelberger et al. , 2017 and UIC , 2020].

Description of the labels.

Network length is the total km of tracks, not especially electrified, with the standard gauge[29].

Population is simply the population of the country on the first of January 2020.

MPkm Passenger Kilometre (Pkm) is the unit of measurement representing the transport of one passenger by rail over one kilometre [Eurostat , 2016]. In this case, it is measured in million passenger kilometres. (Netherlands has a * because its data for the entire train sector is not available. This is the Passenger-Kilometre for NS, the incumbent and main operator).

Passenger Ratio is the ratio of MPkm over the population of the country, for the sake of comparability. (The ratio of Netherlands is underestimated because of the lack of information concerning the $MPkm$).

[29]spacing of the rails on a railway track

GDP/capita stands for the real GDP/capita for the year 2019.

Revenue stands for the average passenger revenue per passenger train-kilometre in 2016.

Punctuality is the percentage of passengers trains that arrive on time and are less than 6 minutes late. Switzerland computes its share accounting for maximum 3 minutes delay. So its share is probably underestimated compared to the other countries studied (Average computed over 2015 and 2016)

Accidents is simply the number of accidents (all types) over one year. (Average computed for 2016, 2017 and 2018).

Accidents Ratio is a ratio of the number of accidents over the Mpkm. It represents the percentage of accidents occurring over 1 Mpkm, . Of course this is not the perfect ratio, it would have been preferable to compare the number of accidents simply with the total number of kilometres travelled in a specific country but unfortunately, this indicator is never reported (because it does not really impact the performance). Once again, since the data concerning Mpkm is not complete for the Netherlands, we can consider that this ratio overestimates the probability of accidents on the Dutch railway sector.
Between brackets, you can find the estimated number of MPkm that "need" to be travelled before 1 accident happens.

The data and their potential implications will be discussed in the upcoming section.

5.2.2 Structural and organisational differences

Institutional setting As seen before, the institutional settings of a country might impact on its performance. In order to understand whether the differences come from the different settings in the coming analysis, you will first find the main characteristics in the next table.

Vertical separation

County	Type of integration	Regulatory Authority	Scope of regulatory powers
Belgium	Separated	Regulatory Body for Railway transport and for Brussels Airport Operations	Offer advice, monitor, resolve conflicts and perform the EET
Netherlands	Separated	Authority for Consumers and Markets (ACM)	Authorised to perform EET and supervisory task (bus/tram/metro)
Switzerland	Integrated	Railways Arbitration Commission (RAC)	Actively monitors network access and track access charges to check that they are free from discrimination
Denmark	Separated	Jernbanenævnet	Minor role in relation to public service contracts
Austria	Holding Structure	Schienen-Control GmbH	Contracting authority on behalf of the Ministry and controls quality criteria

Table 3: Type of Integration and regulatory powers of NL, CH, DK and AT. Source : Own elaboration on basis of [Ángel Caramello-Álvarez , 2017; EU Open Data Portal , 2018 and REGUL , 2020b].

5.2.3 Investments

Investments are known to impact substantially on the rail performance. In the next graph, you can find the level of investment for Belgium, the Netherlands, Switzerland, Denmark and Austria. For Denmark and Netherlands, no data was available concerning the total investment (Infrastructure Managers + Operators), therefore, the data in the graph represents only the investment made by the biggest operator. As a comparison

you can find the investment of the SNCB only for **Belgium***.

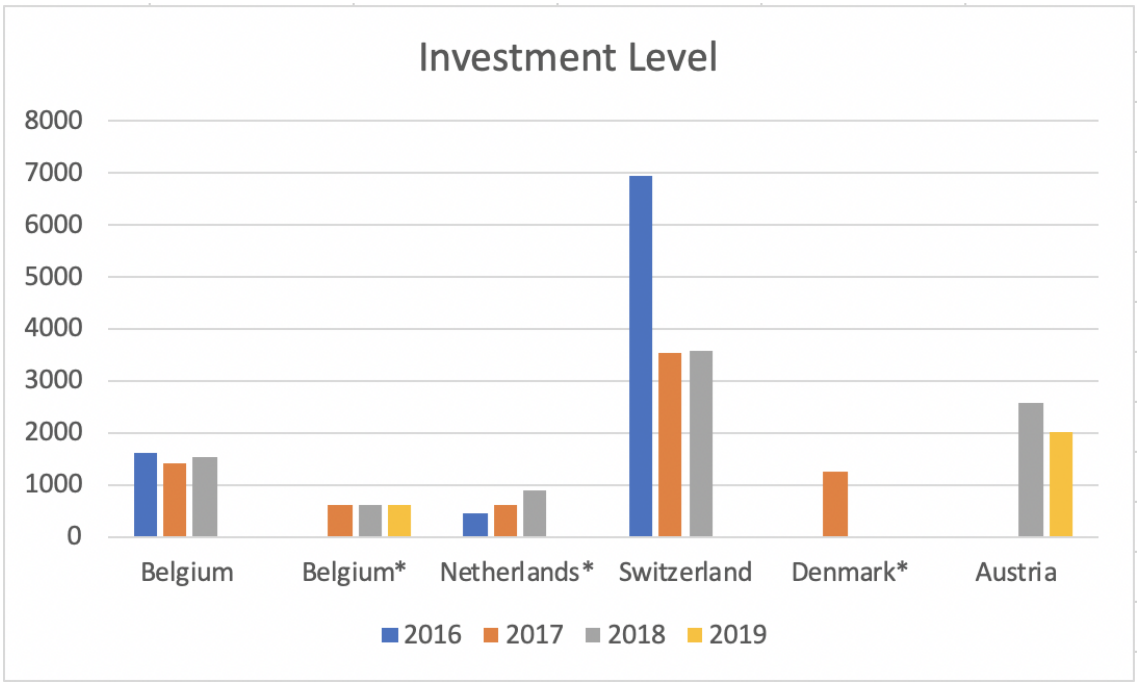

Figure 4: Investment Levels in thousand of euros, of BE, NL, CH, DK and AT. Own elaboration with the data of [Durt et al. , 2020, UIC , 2020, Swiss Travel System , 2020, ÖBB , 2019 SNCB Public Affairs , 2019]

Gathering data on investment was of the upmost difficulty. Since the data mostly come from the Infrastructure Managers or the Operators themselves, they might not be completely accurate. Yet, it gives a good general insight on the level of investment in the different countries.

5.2.4 Implementation of competition

Last but not least, understanding how competition applies in the different countries will help us to get an insight on how relevant this is. In this respect, I computed the shares of the market (in Million-Pkm) and the way contracts were awarded. You can find the graph just below.

Switzerland is a special case. Since it is completely vertically integrated with its 12 different operators on the standard railway tracks (29 more on the narrow tracks),

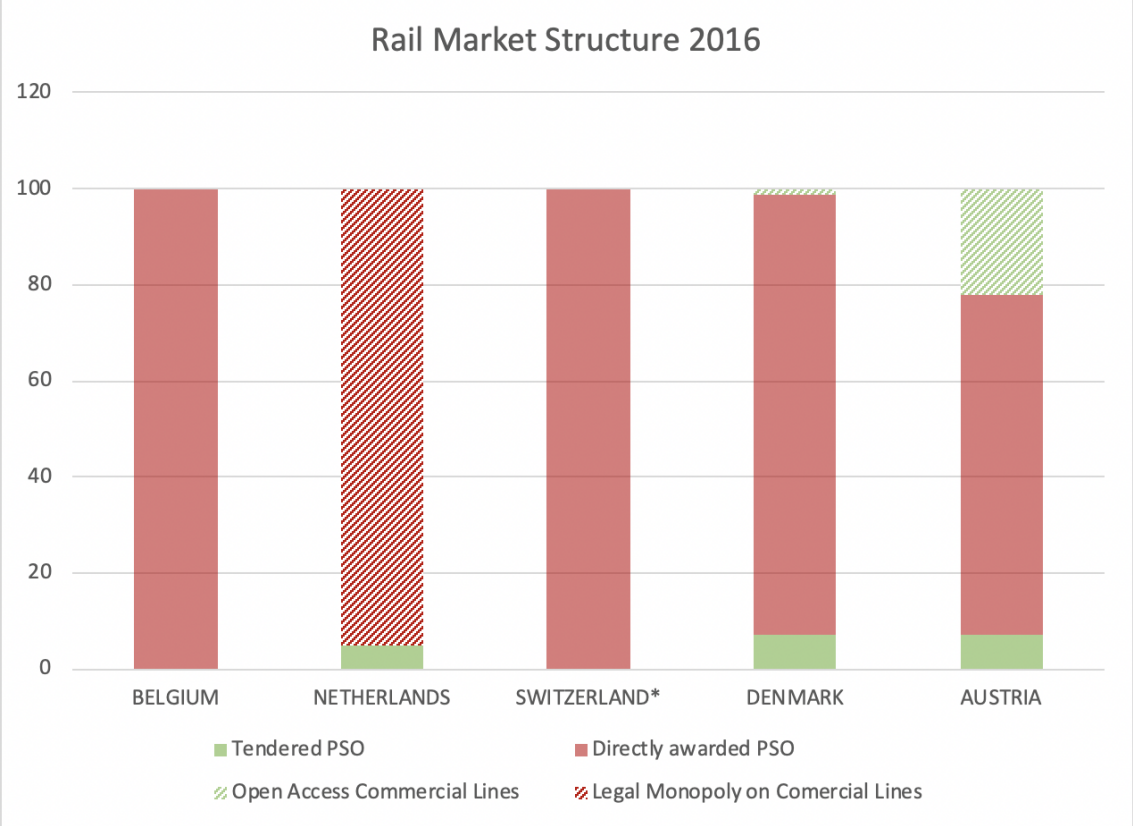

Figure 5: Market shares of the different types of contracts attribution in BE, NL, CH, DK and AT. Own elaboration with the data of Ángel Caramello-Álvarez , 2017; EU Open Data Portal , 2018]

it is considered as directly awarded. Yet, as seen in the previous sections, even if the competition is not "visible", Switzerland applies competition by comparison, with their performance constraints. [Ángel Caramello-Álvarez , 2017, Desmaris , 2014]. As comparison, Belgium only has 1 RU, The Netherlands has 5, Denmark has 3 and Austria 12, on their passenger market [Ángel Caramello-Álvarez , 2017, EU Open Data Portal , 2018].

6 Discussion

6.1 Previous conclusions of literature

All things considered, liberalisation might be seen as an expensive, unnecessary and welfare decreasing process. The first reason behind this is the increase in public cost. Great-Britain, that has seen a significant liberalisation saw its level of public cost rise considerably (from less than one billion pounds a year at its lowest before privatisation to more than seven billions pounds after its application). Recently, the public cost stabilised to around 5 billions pounds per year. This impact has also been observed in Sweden where this has gone from SEK 3 billion in the pre-liberalisation period to a peak of nearly SEK 12 billion in 1995. The situation in Germany is similar to that of the other two countries. This might be due to the multiplication of railway operators leading to coordination costs between the management of infrastructure and operations that may be significant [Malay and Keirsbilck , 2019].

The second reason is vertical separation. Without strong regulation, vertical separation may be ineffective at reducing costs [Smith et al. , 2018]. For Velde et al. , 2012, it even increases total rail system costs by 20 percent [Velde et al. , 2012]. One possible reason behind these findings is that vertical separation can lower synergies or scale economies (conversely to horizontal mergers) [Belleflamme and Peitz , 2010], meaning the cost of operating becomes higher.

The third reason concerns Open Acess Operator (OAO). According to Wheat et al. , 2018, OAOs are disadvantaged, relative to FIOs, due to their low frequency of operation, all other factors being equal. It is foreseen that OAOs are operating with substantial returns to density and thus from this evidence are considerably further from the minimum unit cost point[30] [Wheat et al. , 2018]. The results of Casullo , 2016, strengthen this view, showing that on-track competition following open access entry does not show

[30]The mean result for returns to density for OAOs is 3.026. This implies that as train hours (or train km) increase by 1 percent, costs only increase (0.01/3.026=) 0.33percent [Wheat et al. , 2018].

operational efficiencies and results in higher unit costs [Casullo , 2016].

Yet, the question of public cost and total cost recieved very little attention when assessing performance. The main factor usually taken into account relative to price is the fare actually paid by the traveller. And the part of the total cost covered by the fare differs considerably from one country to another.

Nevertheless, there is another viewpoint about liberalisation, more in line with the theoretical economic predictions. The findings of Mizutani et al. , 2015 and Smith et al. , 2018, support the positive (or at least non-negative) outcomes of liberalisation. The holding model did not increased costs, the vertical separation reduces them if the train density is low, and strong regulation also reduces the costs [Smith et al. , 2018].

Other findings supporting this opinion, concerning the OAO this time are the ones of Wheat et al. , 2018. They found that OAOs are 34 percent cheaper than FIOs, concluding that competition in the market and for the market can co-exist without major cost disadvantage. The findings of Feuerstein et al. , 2018 also point to the same conclusion. They show that open access competition is overall perceived to have a positive effect on long-distance passenger rail and that this tool would allow a decrease in the overall transport emissions [Feuerstein et al. , 2018].

But how will all these findings impact the Belgian rail performance? This is the question I attempt to answer, starting with a description of the Belgian's current characteristics of performance, and then analysing the possible outcome and consequences.

6.2 About Belgium

Belgium ranked 14th in the last two rankings of the BCG Rail Performance Index (RPI) [Duranton et al. , 2015; Duranton et al. , 2017] and this might seem a bit disappointing. The question of a poor ranking can be posed, considering that Belgium opened the very first railway on the European mainland. That was the railway line

between Brussels and Mechelen, inaugurated on May 5, 1835 [Infrabel , 2020]. To that extent, an analysis of the RPI with respect to their country GDP might give us some insights on the logic of this index. In order to understand whether the index made sense for Belgium, I computed the regression of the Real Gross Domestic Product (GDP) on the Score obtained in the Railway Performance Index for the three different years, using the real GDP matching with the years of the data used for the RPI computation. Both Norway and Luxembourg have been removed from the regression due to their particular geographical and demographic particularities. You can find the regression with Norway and Luxembourg included in the Appendix C. When combining the three regression data together the following is obtained :

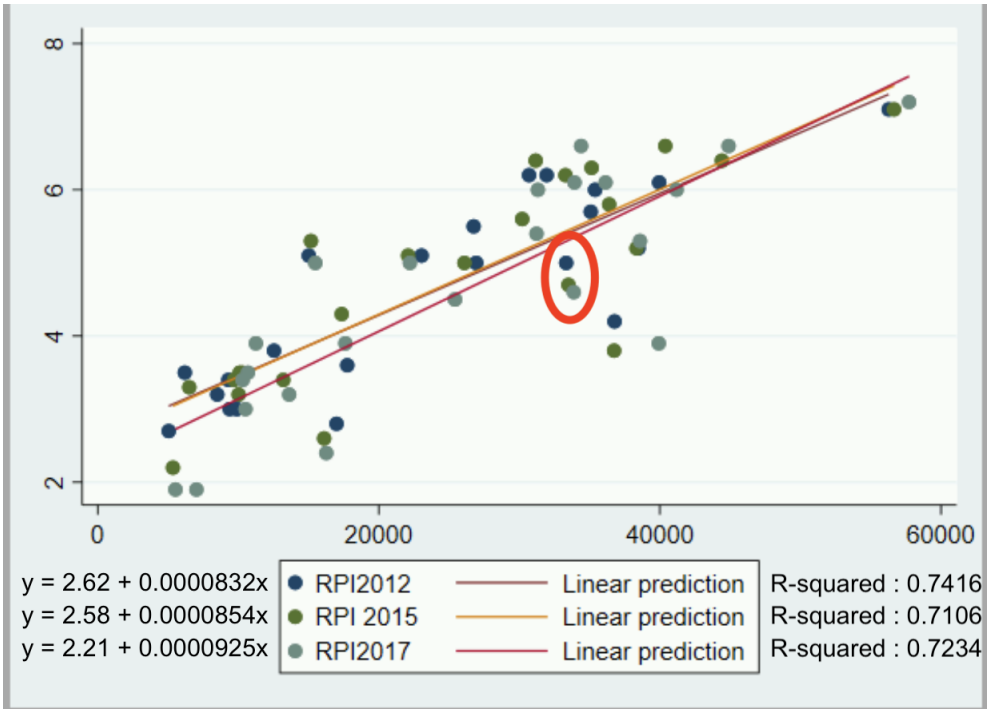

Figure 6: Simple Linear Regression, Real GDP and RPI Score. Own elaboration with the data of [Duranton et al. , 2012; Duranton et al. , 2015; Duranton et al. , 2017 and Eurostat , 2020b].

The dots corresponding to Belgium are the ones encircled in red. The model is quite simple and does not reveal much[31]. But one conclusion that might be drawn from

[31]You can find the 3 different regressions in appendices D, E and F

this model is that for the 3 consecutive indexes, the RPI score of Belgium is more disappointing than outstanding. The performance of Belgium seems to be a little inferior to where it is "supposed" to be, following the prediction, at least compared to the real GDP.

The unsatisfactory results of Belgium might mean that there is room for improvement. Will competition provide the solution?

6.3 Comparison of indicators

6.3.1 With respect to Competition

In their first report, BCG tried to correlate performance with liberalisation, but they did not managed to link the two directly. For BCG, at the time, the countries that had made the effort of liberalisation were the ones striving for high performance. It also highlighted the fact that other factors came into play in determining high performance, without stipulating which ones [Duranton et al. , 2012].

When we analyse this from the opposite angle, asking ourselves which factors determining performance (from the the RPI) can be impacted by competition; the ones that stand out significantly are passenger volume, the number of accidents, punctuality and fares.

Passenger Volume Theoretically, the goal of implementing a wider competition is to increase the modal share of the train, and therefore, increase its numbers of passengers. This can be induced by numerous factors. A price reduction (also expected by competition), an increase in the consumer satisfaction, better connections, more convenient time-tables, etc. all lead to a theoretical increase of travels or travellers.

Netherlands, Switzerland, Denmark and Austria all have higher Pkm than Belgium relative to the population size (you can observe it in table 2). This can not be concluded as pure confirmation of the previous hypothesis, especially since the highest rating

belongs to Switzerland and that it has no actual competition on its rail, although it still aims the same way. Furthermore, since the Pkm is taken into consideration in the index configuration, and that all the other countries studied outperform Belgium, the information might seem redundant.

Accidents The effects that competition might have on accidents are less clear. Indeed, there is no explicit link or data available to compute it. I share the opinion expressed in Malay and Keirsbilck , 2019, that says : it is clear that the number of accidents highlights the level of safety of a network and thus its quality, the available information does not allow us to judge the quality of the rail network and its the impact of liberalisation on the number of railway accidents[32]. But we do not have data that would allow us to prove it [Malay and Keirsbilck , 2019].

Punctuality Theoretically, the effect of competition over punctuality is clearer. Higher pressure on the different undertakings to satisfy the consumer should push the RU to strive for punctuality, which is an important component of determining the traveller's satisfaction. When referring to the data, we can see that all other countries studied have a significantly higher percentage of trains arriving on schedule. Even with half the margin of Belgium (3 minutes instead of 6), Switzerland still continues to outperform Belgium. For Netherlands and especially Denmark and Austria, the data give nearly impeccable scores, that might be induced by the competition on their railway.

Nevertheless, the subject of Belgium and punctuality is a difficult one. The Belgian "Jonction Nord-Midi" or Line 0 Brussels-South - Brussels-North is notoriously known for its recurrent delays. The issue is that in the heart of Brussels the intermediary central station comprises only 6 railway tracks (narrowed from over 20) by which most trains pass though, thus creating the bottleneck for the entire Belgian railway.
Indeed, at peak hours, no fewer than 88 trains pass through the six-track tunnel every

[32]Some attribute the two major accidents in Hatfield and Ladbroke Grove (Great Britain) to the under-investment in the network induced by liberalisation [Malay and Keirsbilck , 2019].

hour - just under the maximum of 96 per hour. The slightest problem in this bottleneck causes enormous delays. To tackle this problem, there's discussion of building a new underground junction. This new tunnel should allow more trains at peak hours and also make it possible to increase the speed of international trains passing through the capital. The work would take ten years and cost 2 billion €, which is is a really heavy investment but strongly encouraged by Pieter Van Steenwegen[33] (KU Leuven) [Eric Steffens , 2019].

Fares Again, fares are supposed to decrease with more competition. Unfortunately, fare observation and comparison is really hard to assess, and I did not manage to access this data for Switzerland and The Netherlands.

But here, the observation seems to say otherwise. The average revenue is at least 2 times higher for Denmark (19€) and Austria (16€) than for Belgium (8€). Yet, the revenue does not only take the fare into account. It can includes all others methods of remunerating the RU, although it can still provide an insight.

Unfortunately, there is little to no conclusions to be made at this level. More research on the actual fare level in similar countries could help to yield more precise results.
All things considered, understanding and assessing the exact impact of competition on rail performance is tricky. Every country has differences, depending on what the initial structure is (vertical separation), on the intensity of use, of investments, and many other factors, the results of implementing competition will theoretically and genuinely be completely different.

In this respect, I will try to determine if these other factors might be drivers of performance in the case of The Netherlands, Switzerland, Denmark and Austria, in the next section. Afterwards, I will conclude which factors Belgium could change in order to enhance its own performance in the rail sector, or be more adapted to encourage

[33]Civil engineer and mobility expert

the implementation of competition, if Belgium follows the directives, the goals could become increasingly close.

6.3.2 With respect to other factors

Public costs For BCG, higher public cost correlates with performance improvement. Public cost is represented by the sum of public subsidies and investments in the system [Duranton et al. , 2017]. But at this game, Belgium is once again one step behind. In 2015 alone the financial flows between the Belgian Federal State and the railway undertakings reached 2,400 millions euros [Gauthier and Salem , 2016]. As we can observe in the following graph, Belgium's performance is disappointing considering the level of public cost.

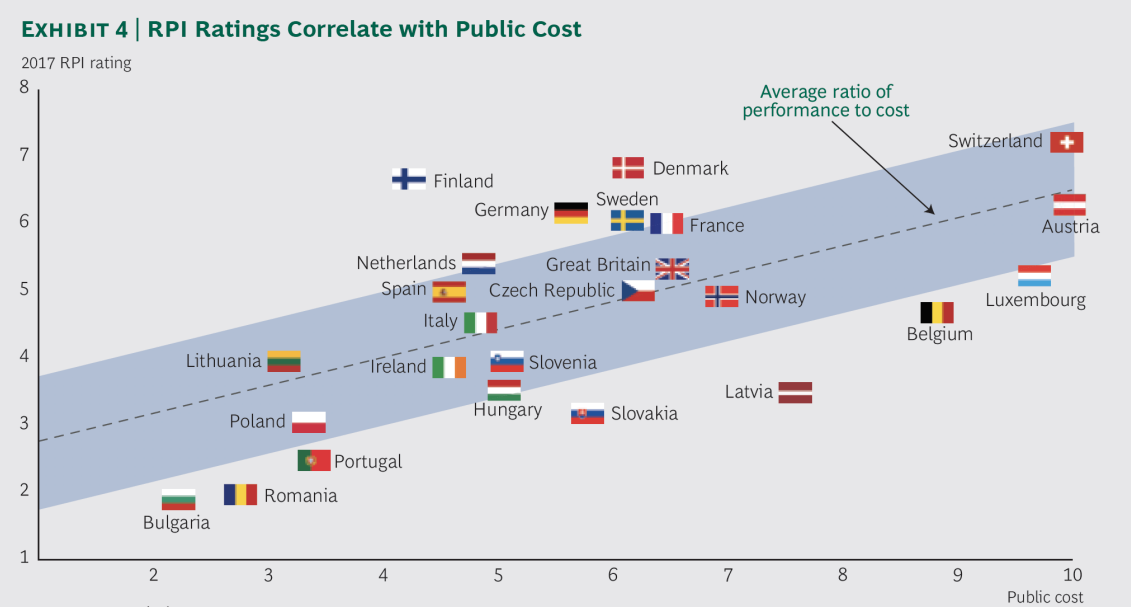

Figure 7: RPI Ratings Correlate with Public Cost, source [Duranton et al. , 2017]

One of the reasons behind the mediocre performance might be that the part of the public cost represented by investments is low. As we could observe in Figure 4, depicting the investment level, the one of Belgium seems rather low. In this respect, one might wonder if the ambitious plan to tackle the North-South bottleneck will succeed in obtaining the appropriate funding.

Another reason that could explain why the high public costs of Belgium and its low performance is the fact that Belgium has a very high number of workers. The study by Gauthier and Salem , 2016, shows the number of Mpkm per employee (or full-time equivalent).

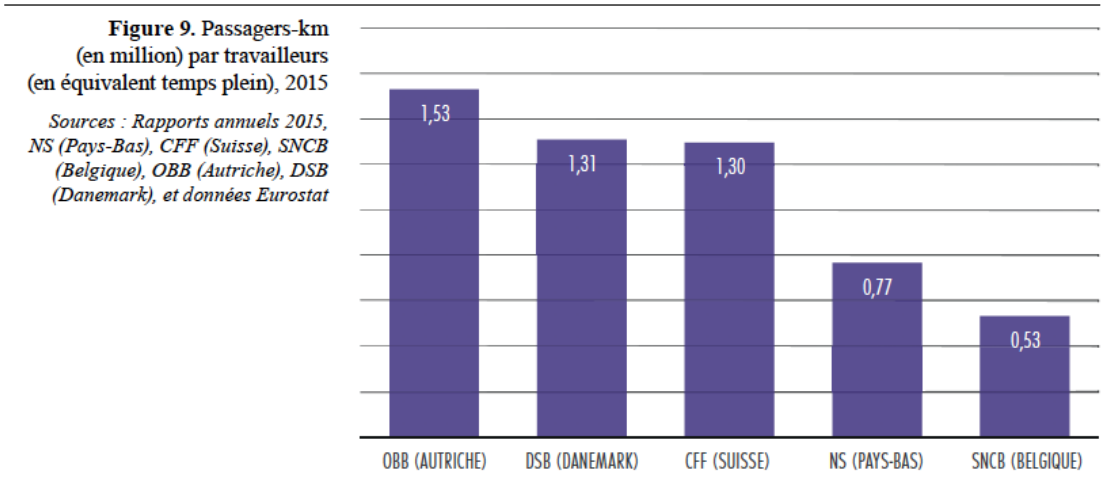

Figure 8: Passenger-km (in millions) per employee (full-time equivalent) 2015. Source : [Gauthier and Salem , 2016].

This graph clearly shows that the number of employees per MPkm for Belgium is extensively higher than in the Netherlands, Switzerland, Denmark or Austria. This mostly demonstrates a poor productivity ratio despite high level of public cost.

What emerges from the analysis of the different public costs is the possible misallocation of the funds. Too much money for the personnel and not enough investment in infrastructure might be behind the disappointing performance of the Belgian rail sector. A thorough analysis of funds allocation in the different countries might help to ascertain the problem better, and comprehension on which factors might need to change or be improved.

Part IV

Conclusion

In the case of Belgium, the most likely scenario to happen with respect to competition implementation, is the one where the passenger market will be awarded to the SNCB for a maximum of 10 years in 2023. Thereafter, national passenger transport will in any event have to be awarded by competition tendered PSO [Malay and Keirsbilck , 2019]. Concerning open access competition, Belgium is protected by the possibility of the EET and the smallness of the market. In other words, the passenger market in Belgium will not have to bother about competition until 2033.

Nevertheless, this is not a valid reason to endorse the disappointing results concerning the Belgian rail performance. The SNCB is not yet ready for a complete liberalisation and if decisions are not taken fast, the SNCB will never be.

Unfortunately, the analysis performed over Belgium, the Netherlands, Switzerland, Denmark and Austria do not give exact results or tailor-made answers to the problem. But it can still help the reflection process and provide some insights over the underlying causes of the problem.

The biggest weaknesses of Belgium railway are its low productivity, low punctuality and low passenger volume. A feasible solution discussed to tackle the low productivity is the possibility of better funds allocation. Concerning punctuality, the big question of the "North-South junction" has been discussed and this highlights the need for high level of investment to remedy the bottleneck and counteract the bad performance. And finally, in regards to the low passenger volume the hope of substantial investments to tackle the punctuality problems and enhancing the passenger satisfaction might be the solution.

My conclusion is the following. It is not the mere fact of competition that will allow for performance enhancement. It is the multiplicity of the factors induced by it that will have the power to create a change for the better. If the SNCB does not want to lose the passenger market and if Belgium does not want to face the spillovers that this might bring (the jobs losses among others), the SNCB needs to improve, and very quickly. 13 years might seem a long time but on the scale of the entire sector it is not. There is hope that the performance of SNCB will improve in the coming years. But as said by the CEO of the SNCB, Sophie Dutordoir, 2019, "*It is up to politics to get on board and give the railway a clear vision*". Without one, defeat will, in my opinion, be assured.

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Appendices

A Ideal Rail Regulator Characteristics

Table 1 Summary of Ideal Rail Regulator Characteristics

Ideal characteristics	Purposes
Independence	Legislative and operational independence from government and railway companies
Stability and predictability	Minimising political influence and promoting the conditions for long-term planning
Non-discrimination	Maintaining a level playing field for operators when accessing the infrastructure
Distinct responsibilities	Avoiding overlapping of roles and accountability between regulator and government (or other agencies)
Human and financial resources	Appropriate resources and skills to meet regulatory objectives
Transparency	Ensuring the accountability of the regulator
Pro-activity and effectiveness	Growing autonomous powers for investigations and interventions
System efficiency	Accessing and analysing data on infrastructure managers' quality and efficiency
Cost-effectiveness	The extent to which the regulator delivers its functions effectively, given its resources (value for money)

Figure 9: Source : [Smith et al. , 2018]. Summary of Ideal Rail Regulator Characteristics

B Organisational and decision-making separation inside the SNCB

		RESPECTE	A MODIFIER
A. L'indépendance décisionnelle			
1. L'autonomie financière			
a) La fixation du budget			X
b) La détermination des redevances		X	
c) Le paiement des redevances			X
2. Les conditions d'accès			X
3. La prise de décision		X	
4. L'autonomie des investissements (indice)			X
B. L'indépendance organisationnelle			
1. Juridiquement distinct ou division		X	
2. La confidentialité			
a) Les relations entre le Bureau RRS et les autres directions de la SNCB		X	
b) Le contenu			X
3. Le système IT		X	
4. L'archivage physique		X	
5. Des locaux séparés		X	
6. La nomination - licenciement/écartement			X
7. L'évaluation du personnel		X	
8. Le cumul des fonctions			X
9. Cooling off (indice)		X	
10. Site web (indice)			X

Figure 10: Source : [Serge Drugmand , 2019]. Findings of the Regulatory Body as mentioned in the investigation report.

C Simple Linear Regression and graphical representation of real GDP over RPI score, with Norway and Luxembourg included

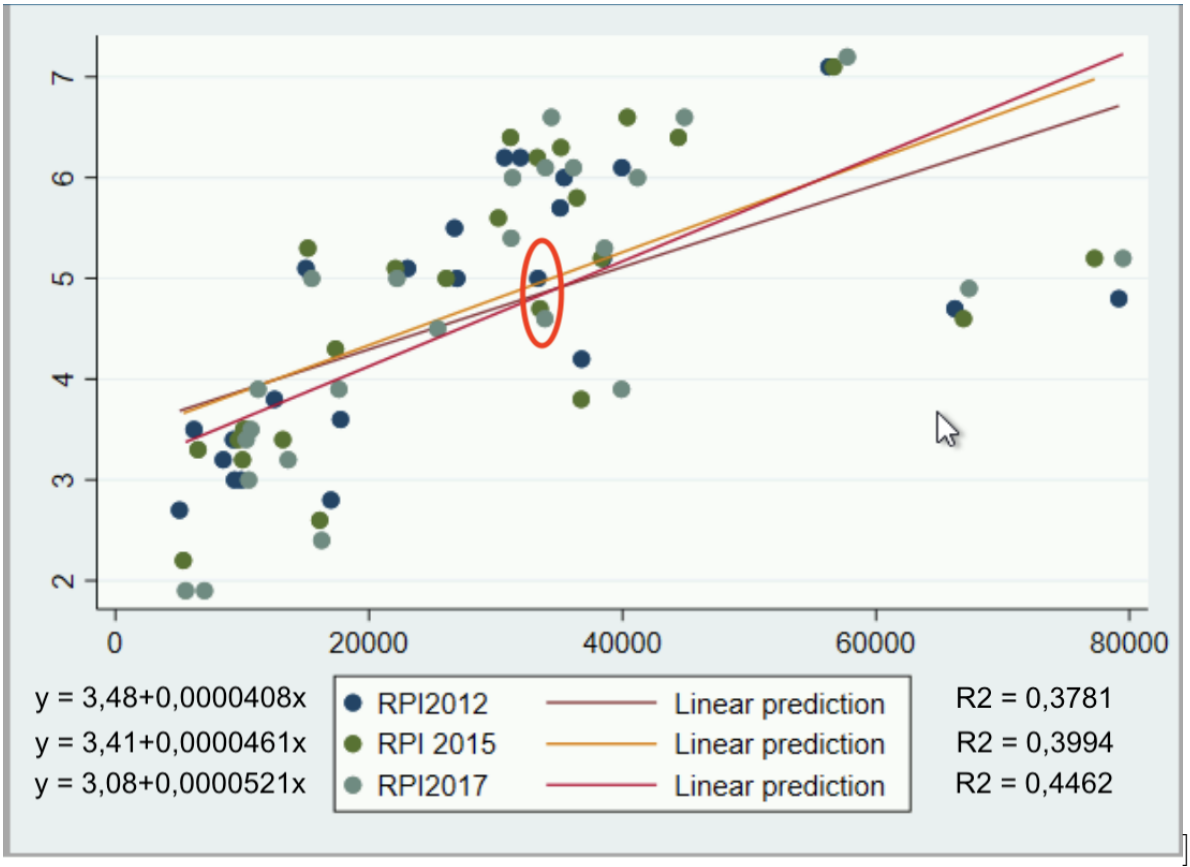

Figure 11: Source : Own computation with data from : [Duranton et al. , 2012; Duranton et al. , 2015; Duranton et al. , 2017 and Eurostat , 2020b]. Belgium dots encircled in red

D Linear Regression and graphical representation, RPI 2012

```
. reg rpi2012 realgdpcapita2010
```

Source	SS	df	MS	Number of obs	=	22
				F(1, 20)	=	57.39
Model	27.5555249	1	27.5555249	Prob > F	=	0.0000
Residual	9.60265421	20	.480132711	R-squared	=	0.7416
				Adj R-squared	=	0.7287
Total	37.1581791	21	1.7694371	Root MSE	=	.69292

rpi2012	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
realgdpca~2010	.0000832	.000011	7.58	0.000	.0000603	.0001061
_cons	2.622012	.3010371	8.71	0.000	1.994059	3.249964

Figure 12: Linear Regression, RPI 2012, own computation. Data : [Duranton et al. , 2012; Eurostat , 2020b]

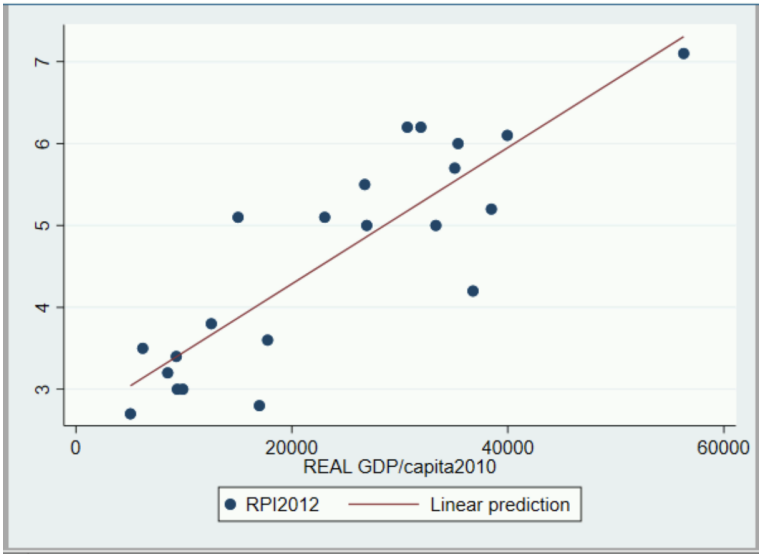

Figure 13: Graphical representation, RPI 2012, own computation. Data : [Duranton et al. , 2012; Eurostat , 2020b]

E Linear Regression and graphical representation, RPI 2015

```
. reg rpi2015 gdp2012

      Source |       SS       df       MS              Number of obs =      25
-------------+------------------------------           F(1, 23)      =   15.30
       Model |  18.0320393     1  18.0320393            Prob > F      =  0.0007
    Residual |  27.1103602    23  1.17871131            R-squared     =  0.3994
-------------+------------------------------           Adj R-squared =  0.3733
       Total |  45.1423995    24  1.88093331            Root MSE      =  1.0857

------------------------------------------------------------------------------
     rpi2015 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     gdp2012 |   .0000461   .0000118     3.91   0.001     .0000217    .0000705
       _cons |   3.415896   .4039101     8.46   0.000     2.580344    4.251448
------------------------------------------------------------------------------
```

Figure 14: Linear Regression, RPI 2015, own computation. Data : [Duranton et al. , 2015; Eurostat , 2020b]

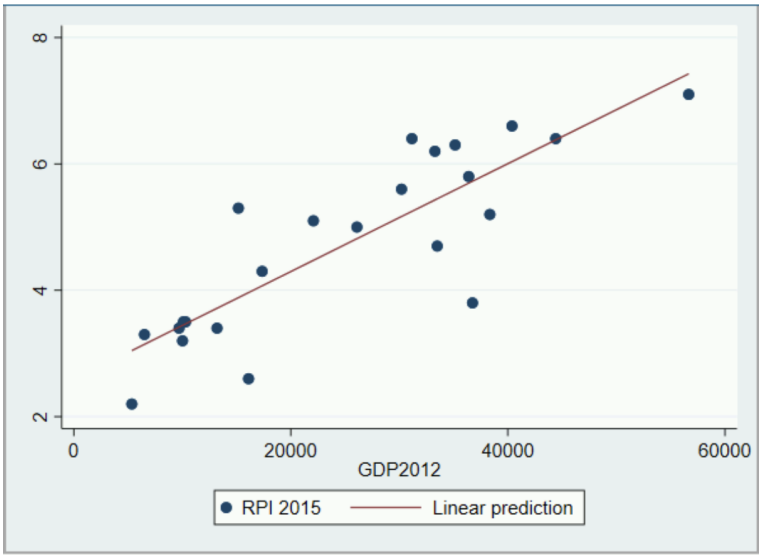

Figure 15: Graphical representation, RPI 2015, own computation. Data : [Duranton et al. , 2015; Eurostat , 2020b]

F Linear Regression and graphical representation, RPI 2017

```
. reg rpi2017 gdp2014
```

Source	SS	df	MS	Number of obs	=	23
				F(1, 21)	=	54.92
Model	38.116862	1	38.116862	Prob > F	=	0.0000
Residual	14.5761786	21	.694103744	R-squared	=	0.7234
				Adj R-squared	=	0.7102
Total	52.6930406	22	2.39513821	Root MSE	=	.83313

rpi2017	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gdp2014	.0000925	.0000125	7.41	0.000	.0000665	.0001184
_cons	2.214066	.3637799	6.09	0.000	1.457544	2.970588

Figure 16: Linear Regression, RPI 2017, own computation. Data : [Duranton et al. , 2017; Eurostat , 2020b]

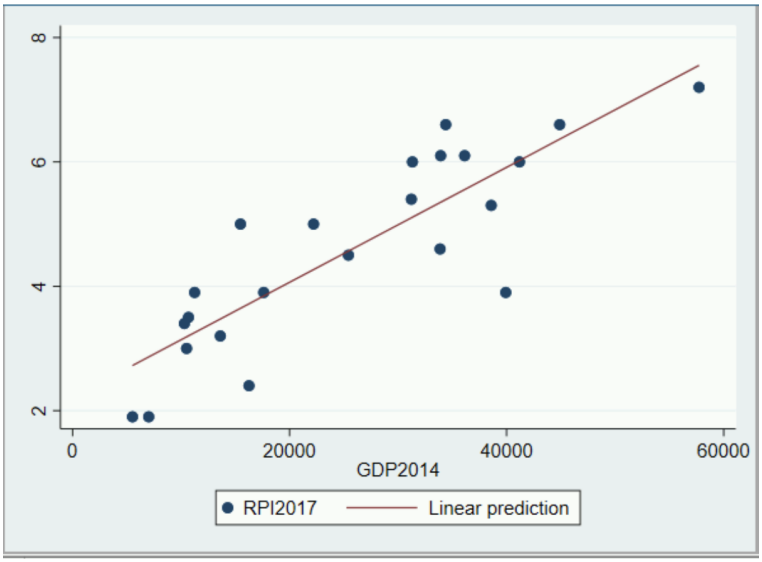

Figure 17: Graphical representation, RPI 2017, own computation. Data : [Duranton et al. , 2017; Eurostat , 2020b]