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Should I Go by Bus? The Liberalization of the Long-Distance Bus Industry in France*

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Abstract

The opening up of the French long-distance bus industry is one of the outcomes of the *Loi Macron*. In this study, we build a unique data set of several representative bus routes and show that the effects of the liberalization have been encouraging in terms of fares, new entry, higher frequency, and higher quality. First, with regard to international routes that used to be under cabotage, we find that relaxing quantitative restrictions has led to the expected results on the Lyon–Torino and Paris–London routes. Second, with regard to domestic routes newly created from the *Loi Macron*, mostly all procompetitive expected variations in the variables have been observed, except for fares. Indeed, we show that bus operators used an initial aggressive pricing strategy to induce demand for the new services and then increased fares once customers became accustomed with the service.

Keywords: Transportation services, deregulation, bus industry, *Loi Macron*, intermodal competition, France.
JEL Codes: L43, L91, G38, R40.

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1 Introduction

In summer 2015, the French government opened up the country's long-distance bus industry to competition.[1] This action was part of a set of measures proposed by the former Minister of the Economy, Industry, and Digital Affairs, Emmanuel Macron, aimed at fostering "growth, activity and equal economic opportunity"[2] (hereafter termed the *Loi Macron*). The main purpose of the reform was to provide a low-cost alternative to rail and thus create new demand for those who would not have opted for rail otherwise. According to a 2016 study by German bus operator GoEuro, France is the fifth most expensive country in Europe for rail.[3] The figures from August 2015 to June 2016 confirm the success of the government's objectives. During that period, bus services allowed 3.4 million passengers to travel. Nonetheless, the bus remains far behind other modes of transportation in terms of market share, accounting for only 2.5% of long-distance travel compared with 67.7% for car, 17.3% for train, and 9.3% for airline.[4]

The proposed reform followed the general move within the EU and United States towards the liberalization of network industries. For instance, regarding transportation in Europe, the first rail liberalization directive was proposed in 1991, while the final air transportation liberalization package was adopted in 1992.[5] Another example is the electricity sector for which liberalization and restructuring have also dominated EU energy policies since the mid-1990s. In comparison with the rail and air transportation service sectors, little European legislation applies to the bus market; hence, there are significant differences between the regulatory environments within member states.

The French situation is specific for at least two reasons related to its policy choice and the particularities of its transportation network. First, over time, France has developed a dense rail network. In 1948, France decided to favor long-distance rail passenger transportation and gave SNCF, the national rail operator, the monopoly for rail transportation services. For occasional trips, implementing bus services for long-distance services was free, but subject to authorization for regular services that could reduce the attendance of existing railway connections. Therefore, a dense network of regular passenger rail connections was developed. In 1981, the country became the first in Europe to invest in a high-speed rail network (i.e., the TGV). This resulted in the

[1] Long-distance bus services include regular and scheduled passenger transportation services–also called express buses or intercity coaches–which satisfy transportation needs outside urban agglomerations, often between cities. The transportation means is usually coaches rather than buses, although no distinction is typically made between buses and coaches in many European countries.

[2] See Loi No. 2015-990 du 6 août 2015 pour la croissance, l'activité et l'égalité des chances économiques. Alongside the liberalization of the long-distance bus industry, the law also included, among other things, the reform of regulated professions, extension of Sunday and evening trading, and simplification of redundancy rules.

[3] For this study, more than 300 million domestic trips made in 40 countries between April 2015 and April 2016 were studied and their cost reduced to a distance of 100 km. `http://www.goeuro.com/transportation-price-index`.

[4] With respect to the total number of trips made in 2014. See "La mobilité longue distance des Français en 2014", *Chiffres & statistiques*, 693, Commissariat général au développement durable–Service de l'observation et des statistiques, November 2015.

[5] On January 1, 1993, the third package of measures for the liberalization of the Community's airline market entered into force. See Burghouwt and de Wit (2015) for an analysis of the EU airline market.

second largest rail transportation network in Europe with 30,000 km of rail services including 2,024 km with high-speed rail capacity.[6] Second, the transportation network has a star-shaped configuration centralized around Paris, which is a legacy of its development in the 19th century. The main routes connect the capital to the north (Lille) and south (Marseille). Therefore, some East-West connections are highly expensive, either by train or by airline. Indeed, some connections do not even exist without passing through Paris. Paris also has the largest French airport, Roissy–CDG.[7]

Until 2011, long-distance bus services were restricted to regional services. For instance, each *département* had the responsibility of organizing intercity bus services within its area (e.g., school transportation). Through a public service delegation contract, a bus operator could be found. International services including operators such as Eurolines also existed but without the possibility of serving domestic cities. In 2011, cabotage was introduced, which allowed international operators to serve domestic passengers, albeit under some quantitative restrictions. Since the enactment of the *Loi Macron*, which removed these regulatory constraints, the popularity of long-distance bus trips has taken off and new market entry has occurred. According to Autorité de régulation des activités ferroviaires et routières (2016), bus services connect 193 French cities, with 261 stops and have an average occupancy rate of 41%.

Based on an original data set that includes nine representative routes over nine months, the initial results show that the procompetitive effects of the *Loi Macron* have been encouraging in terms of lower fares, new entry, higher frequency, and higher quality. With regard to international routes that used to be under cabotage, relaxing the quantitative restrictions has led to the expected results on the Lyon–Torino and Paris–London routes. Second, with regard to domestic routes newly created from the *Loi Macron*, most of the procompetitive expected variations in the variables have been observed, except for fares. Indeed, we show that bus operators used an initial aggressive pricing strategy to induce demand for the new services and then increased fares once customers became accustomed with the service.

Our work relates to several strands of the literature. First, there is a stream of the theoretical literature on public economics and regulation in transportation industries (Kahn, 1988; Hensher, 2007). The latter has been characterized by relatively strong levels of state intervention in the functioning of markets because of previous market failures (e.g., natural monopolies, information asymmetry) and dissatisfaction with the market outcome from a socio-political point of view (e.g., minimum transportation standards, social justice, geographical distribution, difficulties in

[6] See `http://www.sncf-reseau.fr/fr/a-propos/presentation/reseau-ferroviaire`. The first European train network was in Germany, with 41,000 km of track.

[7] In our study, airlines are not considered for several reasons. First, airlines amount for a relative low number of domestic passengers compared to other modes of transportation (9.3% of the total domestic traffic). Second, the low-cost carriers (LCC) for domestic connections in France are not much developed, contrary to what can be observed for intra-European connections. Third, the routes considered in the empirical analysis do not have direct airline connections. Fourth, with regard to cost, apart from the routes served by LCC (2 out of 9 in our study), the average revenue per passenger-kilometer (pkm) varies from 0.2 €/pkm to 0.7 €/pkm (0.1 €/pkm for connections served by LCC). Clearly, this mode of transportation is not a close substitute to bus or carpooling in France.

coordinating different transportation modes). Second, a number of recent studies have examined the empirical effects of past deregulation experiences in network industries (e.g., the seminal work of Morrison and Winston (1986) for airlines), particularly in various long-distance bus markets in Europe (e.g., White and Robbins (2012) for the United Kingdom;Dürr et al. (2016); Dürr and Hüschelrath (2015; 2016); Knorr and Lueg-Arndt (2016) for Germany; Alexandersson et al. (2010); Aarhaug and Fearnley (2016) for Norway; and Beria et al. (2015) for Italy). Liberalization has often had positive effects on potential passengers by improving the supply of bus trips in terms of fares, frequency, and innovation. However, in some cases, the industry has consolidated through external growth, and few firms have emerged and progressively dominated the market (see Cowie (2002) for the United Kingdom).

The rest of the paper is organized as follows. Section 2 summarizes the regulation context and progressive liberalization of the intercity bus industry in France. Section 3 describes the empirical strategy, hypotheses, construction of the data set, and results. Section 4 concludes and discusses the future research agenda.

2 Liberalization of the Long-Distance Bus Market in France

As mentioned in the Introduction, the French long-distance bus market used to be highly regulated. In this section, we briefly describe the evolution of regulation in this market and proactive role of the competition authority (Autorité de la concurrence, ADLC hereafter) in fostering competition. We then discuss the enactment of the *Loi Macron* and role given to the transport regulator with respect to routes under 100 km. Finally, we present the economic environment and largest bus operators.

2.1 Regulatory background

Before 2011, most long-distance transportation services were either forbidden or strictly controlled with the only intercity bus transportation services those contracted by the transportation authorities (see Autorité de la concurrence (2014) for a thorough history of the intercity bus services market in France). These services included i) intercity connections established by *départements* or *régions*; ii) replacement services for intercity trains to neighboring *régions*, subject to agreement between two neighboring regions; and iii) routes described as of "national interest," i.e. where the state was supposed to be the organizing authority but which were delegated based on agreement between and to the benefit of other transportation authorities (this affected only three routes: two between Picardy and Roissy airport and the link between Beauvais airport and Porte Maillot in Paris).[8]

[8]In France, a transportation authority is a public authority to which the LOTI law for inland transport No. 82-1153 of December 30, 1982 entrusted the task of defining the service policy, namely the pricing policy of passenger transportation. In general, the transportation authority entrusts the operational mission to a private

In 2010, following the application of the 2009 EC regulation on bus services,[9] French legislation integrated the possibility of cabotage. The EU defines cabotage as

> "the picking up and setting down of passengers within the same EU country in the course of a regular international service provided that cabotage is not the principle purpose of the service."[10]

In France, cabotage was allowed under three cumulative conditions: i) it did not exceed 50% of the traffic and sales (i.e., cabotage routes were supplementary to the international service); ii) the existence of domestic regular intercity services did not compromise the economic equilibrium of a public service contract for passenger transportation (e.g., rail); and iii) cabotage routes could only serve one city per region. In addition, routes were to be submitted for approval by the Ministry of Transport, in consultation with the *régions* and the *département* concerned in terms of their impact on the economic balance of existing public service contracts.

2.2 French competition authority's expertise

The Adlc contributed to unlocking a sector that previously was subject to the above-described regulatory constraints, which penalized consumers willing to take advantage of another transportation mode. It advocated two regulatory regimes depending on the distance between the connected cities. Beyond a certain distance, the authorization to open a new route should be granted automatically by the regulator since the risk of consumers being diverted from public rail services to a private bus operator is low. The Adlc proposed a 200 km threshold beyond which the two transportation modes are no substitute for one another (Autorité de la concurrence, 2014, §361–363).

It showed that before liberalization the decision to ban new bus routes often lacked economic justification. Specifically, the existence of a rail service parallel to the proposed bus connection was often the main criterion to justify such decisions. In the vast majority of decisions, the level of substitutability between different modes of transportation had not been analyzed (Autorité de la concurrence, 2014, §269). Some *régions* had only mentioned the existence of a TGV line to reject the entry of a bus service without assessing the competitive constraint that the bus could have represented for the TGV (Autorité de la concurrence, 2014, §272).

In addition, the decision-making process at the national level could be subject to conflicts of interest (Autorité de la concurrence, 2014, §271). Indeed, the state was a shareholder of both the train operator SNCF and the transportation industry regulator. Moreover, the *régions*

or a public transportation company. For instance, since 2001, *régions* have become the public transportation authority for regional rail passenger transportation. The regional rail service is provided by SNCF in return for financial compensation from the *région*.

[9] Regulation (EC) No 1073/2009 of the European Parliament and of the Council of 21 October 2009 on common rules for access to the international market for coach and bus services, and amending Regulation (EC) No 561/2006 (OJ L 300, 14.11.2009, pp. 88Ð105).

[10] *Ibid.*

consulted about opening a bus route often partly financed railway infrastructure. A number of *régions* thereby denied opening a route to protect their own investments in rail.

Unsurprisingly, the expected bus operators' profitability therefore reduced. The lack of economic analysis evaluating competitive pressure exerted by bus services on other modes of transport, combined with a lack of transparency in decision making, created considerable uncertainty for bus operators, especially in their ability to predict the probability of a new route being approved. The ADLC regretted the absence of low-cost alternative modes and lack of rail options by claiming that "Bus services could also develop and attract customers on non- or under-served collective mode routes, including routes for train stations or airports" (Autorité de la concurrence, 2014, §170). The ADLC's recommendations–including opening up intercity routes to competition–were thus taken up by the legislator to the benefit of most consumers.

2.3 The 2015 *Loi Macron*

Article 5 of the *Loi Macron* states that "Road public transportation companies of persons established in the country can ensure long-distance scheduled services" (authors' translation). This article updates the *Code des transports* by marking the creation of an intercity bus transportation market in France. When routes exceed 100 km, buses are free to compete with rail services without prior authorization. On the contrary, when the distance between two consecutive stops is less than 100 km, provided that the new bus service does not compromise the economic balance of public contract services, an economic analysis of the substitutability between public rail and road transportation must be carried out.

In practice, below the 100 km threshold, the *Loi Macron* provides that bus companies have to apply to Arafer (Autorité de régulation des activités ferroviaires et routières, 2015). Once notified, the regulator has two to three months to deliver a ruling, including limiting or prohibiting the notified route if necessary. As of August 2016, bus operators had notified 182 routes to the regulator.[11] Eighty-two claims had been filed by *régions* or other organizing authorities fearful of an "economic imbalance" on their subsidized intermodal routes.

The distance threshold level below which bus connections begin to be regulated was controversial in the debates preceding the enactment of the *Loi Macron*. In Germany, a similar threshold is 50 km, whereas it is 200 km in Sweden. The threshold depends on how the transport network and alternative modes are developed in the given country. If the threshold is too high, a significant share of market connections are not deregulated, possibly leading to a heavier workload for the regulatory agency. However, if the threshold is too low, the liberalization of certain routes could harm the contracted public transport operators, as noted by the Senate and the ADLC. Indeed, the latter advocated a 200 km threshold.

One argument in favor of a threshold below even 100 km was to foster a bus route network better suited to areas poorly served by rail and thereby create new routes. However, the

[11] See `http://www.arafer.fr/les-autocars/declarations-de-liaisons-et-saisines-de-larafer-2`.

threshold was not set to 50 km as in Germany since it would have harmed subsidized interurban transports. Here, the région maintains the infrastructure of the train network and the *département* manages intercity bus services.

2.4 Bus operators' strategies for the French market

SNCF responded to the *Loi Macron* by introducing its own intercity bus services under the banner of iDBus. These services included new international routes in the north such as Rotterdam via Antwerp and Lille. In September 2015, the company renamed its commercial offer Ouibus and in the period to early 2016, Ouibus carried 267,000 travelers on the 110 lines, by using subcontractors. This commercial risk-free model includes eight local groups such as Salaün in Brittany and Faure in Rhône-Alpes.

Another group, Transdev, which is 60% state-owned, is aiming to become a EUR 100 million business in two years, with 1,000 employees and five million passengers.[12] Transdev is already the leader on international routes under its Eurolines brand. Its intercity connection buses in France now operate under the new brand Isilines. Since July 2015, Isilines has developed 17 domestic routes interconnecting more than 50 cities and seven new longer routes including Nice to Toulouse to Bordeaux.

Starshipper entered the market by focusing on small and medium-sized enterprises in the sector. The company is a network of independent bus operators that provide services to Rennes, Nantes, Angers, Le Mans, and Lyon from Paris.[13] Further, a Toulouse to San Sebastian route has opened in the southwest, serving Pau, Bayonne, Biarritz, and Saint-Jean-de-Luz.

Megabus–a subsidiary of the UK Stagecoach group–has established an operational base in the suburbs of Lyon. It has also created two new international routes: Barcelona–Frankfurt, which serves Perpignan, Montpellier, Avignon, Lyon, and Mulhouse, and Milano–London via Lyon, Paris, and Lille. The company has adopted a dynamic pricing strategy whereby fares vary depending on demand and booking period.

In Germany, FlixBus serves 1.5 million passengers monthly, accounting for 70% of the domestic bus market in 2015.[14] Its novelty is that it does not own any buses and does not hire drivers. Its "Uber-like" business model means that its investment is much lower than that of its competitors. It emphasizes quality, price, and a user-friendly experience by investing heavily in technology. Transport is franchised to local bus operators based on an innovative legal and financial structure using application platforms from Apple and Google. Revenue and risk are thus shared (70% for the local bus company and 30% for FlixBus).[15]

[12] *Ibid.*

[13] Interestingly, the bus operator was acquired by SNCF on June 2016, therefore leading to the merger of OuiBus and Starshipper brands. In the following empirical analysis, brands will be still distinguished since the merger occurred later than the end of the study period. We discuss the consolidation of the market in the conclusion section.

[14] *Ibid.*

[15] "Autocars: la guerre des petites lignes", *Les Échos*, January 16, 2016.

Table 1 presents the market shares of these bus operators. Since the enactment of the *Loi Macron* to June 2016, bus operators realized a turnover of EUR 40 million (Autorité de régulation des activités ferroviaires et routières, 2016).

Bus operators	**Market shares**
Isilines/Eurolines (FR)	35%
FlixBus (GER)	23%
Ouibus (FR)	28%
Megabus (UK)	6%
Starshipper (FR)	8%

Table 1: Bus operators in the domestic long-distance bus services market (June 2016)

The average long-distance bus passenger is budget-constrained. According to Pierre Gourdain, former General Manager France-Belgium of FlixBus, "40% of the French cannot afford a train ticket. We have a public service that has become a kind of luxury. Long-haul bus rides are a new way to travel in France with less than 5 cents per kilometer" (authors' translation).[16] With regard to Isilines, 99% of its passengers choose to travel by bus primarily because of its low price.[17] Complementarity with urban networks and timetables are also important for travelers (50%), followed by comfort and the ability to take more luggage on board (40%). These passengers are primarily young people (more than 60% are aged 20-40) and one-third are students. Moreover, these bus routes are attracting new travelers and many passengers who previously used the train or were involved in carpooling. During the week, the majority of passengers are students and people without work constraints; during school holidays, they are families with children.[18]

Carpooling has emerged as an economical alternative transportation mode.[19] The leading French web-based company BlaBlaCar has 20 million members in 19 countries.[20] The company bought its German rival Carpooling, and its six million members, valued in 2015 at over $1 billion. Its business model, a commission of 10% to 12% levied on all transactions on the platform, is still relatively new. BlaBlaCar would seem to be a strong competitor to the new long-distance bus operators, which are aligning their prices to those observed on the platform.[21] Our database includes BlaBlaCar's prices.

Faced with increasing competition from bus services and the growth in carpooling, SNCF

[16] *La Montagne*, September 9, 2016.

[17] Figures are taken from the customer survey by bus operator Isilines. See "Qui sont les voyageurs convertis à l'autocar?" *Le Figaro*, September 30, 2015.

[18] *Le Nouvel Observateur*, October 20, 2016.

[19] However, compared with buses, there is a risk of not getting along with a given driver or having to make conversation during the trip. Therefore, buses seem more anonymous and may be preferred by some passengers.

[20] "BlaBlaCar, Something to chat about", *The Economist*, October 24, 2015.

[21] However, the start-up was not free of legal problems. In Spain, the bus union accused the carpooling leader of unfair competition ("Spain: Bus operators call for ban on BlaBlaCar", *Competition Policy International*, August 12, 2015).

has changed its strategy to "consolidate its leading position" as a multimodal operator.[22] Its new long-distance travel offer provides high-quality TGV services at the top of the range; in the mid-range, intercity and TER services have been revamped and are now fully operational; in its low-range, all discount offers are grouped under the OUI brand, including Ouibus.

3 Empirical Analysis

From the perspective of consumers, the primary interest in creating long-distance bus services is the introduction of lower fares than those offered by other transportation modes such as trains. In the bus market, capital requirements are low, sunk costs small (owing to easily redeployable assets), and entry and exit relatively easy. These factors encourage new entries, raise demand, provide more services (e.g., Wi-Fi on-board), increase cost efficiency, and, as a result, create new jobs. We investigate the dynamic impact of liberalization on structural dimensions (i.e., number of bus companies, fares, frequency, quality), controlling for demand characteristics. In the remainder of this section, we summarize the general effects of deregulation and resulting hypotheses to be tested in Section 3.1. We then present the French data, selected routes, and descriptive statistics (Section 3.2). We finally build the testable hypotheses, carry out the subsequent tests, and provide a data analysis (Section 3.3).

3.1 General effects of deregulation

The effects of deregulation depend on the extent to which the industry was regulated before. European experiences of long-distance bus services deregulation suggest the following five key outcomes on which the hypotheses to be tested on the supply side of the French market will be based.

First, the number of operators and services increases in the short-term, especially on main routes. For instance, in Germany, following its 2013 deregulation, new entrants joined the market and introduced service innovations. Dürr and Hüschelrath (2015) and Dürr et al. (2016) find that route-level average fares depend on the number of competitors as well as on the composition of the firms operating a particular route. Hence,

> *Hypothesis 1. Removing quantitative restrictions on existing routes fosters new entry, possibly with aggressive pricing strategies.*

Second, bus fares generally decrease significantly, especially in the short run, because of the competition in the long-distance bus industry as well as that between buses and other transportation modes, mainly rail and now carpooling. For example, Robbins and White (1986) show that large price reductions took place in the United Kingdom, which was the first country in Europe to deregulate its intercity bus industry. Consequently, costs and thus profit margins

[22] See "Ouigo to expand as SNCF rethinks low-cost services" *Railway Gazette*, September 3, 2015.

reduce. In the long-term, fares may increase to some extent to finance investment. In the United Kingdom, Nash (1993) finds a 30% reduction in cost efficiency. However, on some secondary routes with declining traffic, which have been cross-subsidized by other routes in the past, fares may increase and services continue to decline. This was observed in the United Kingdom (Robbins and White, 1986) for lower-density cross-country routes. This may have reflected the removal of the previous cross-subsidy within the bus network. Hence,

> *Hypothesis 2. Removing quantitative restrictions on existing routes leads to lower fares, especially when intermodal competition is fierce.*

Third, new operators may establish themselves through aggressive marketing and by providing high-quality services. For instance, this strategy was adopted by FlixBus in the German market (see Dürr and Hüschelrath (2016) for an empirical analysis of its entry strategy) or by TIMEkspressen in Norway (Aarhaug and Fearnley, 2016). Hence,

> *Hypothesis 3. Removing quantitative restrictions on existing routes improves services (i.e., higher frequency and higher comfort).*

Fourth, bus deregulation may lead to lower rail prices, which serves as one of the indirect benefits of intermodal competition (see Robbins and White (1986) in the United Kingdom). Hence,

> *Hypothesis 4. Removing quantitative restrictions on existing routes fosters intermodal competition and makes train and/or carpooling fares cheaper.*

Fifth, larger operators with major route networks and bus terminals manage to increase their businesses and, in the long-term, some of these may come to dominate parts of the long-distance scheduled bus route business, using, for instance, M&A strategies to grow. In Norway, the industry experienced a wave of mergers following post-deregulation growth. The 30 operators that existed in 2001 shrank to 12 in 2015 (Aarhaug and Fearnley, 2016). In the United Kingdom, Cowie (2002) shows that following deregulation, growth was realized by M&A rather than by developing demand directly, which resulted in the dominance of the market by a few operators. Hence,

> *Hypothesis 5. Following the opening up to competition, M&A strategies occur, marking a period of consolidation.*

Same types of hypotheses can be made when deregulation leads to the creation of new routes (i.e., new markets). In the next subsection, we present the data on which the above key elements will be tested.

3.2 Database and methodology

First, we justify the choice of the nine routes used in the empirical analysis. We provide not only their individual characteristics but also information about the connected cities. Next, we

present the data collection methodology. Finally, we describe descriptive results for the price dynamics for each transport mode and route.

3.2.1 Selection of the bus routes

The data collection period started 15 days after the implementation of the *Loi Macron* on August 20, 2015. As there was no existing database, we had to collect an original data set.[23] We focused on nine routes representative of the French market. Several selection criteria were used. The first was to consider both i) routes (including international routes) for which regular services were allowed before the enactment of the *Loi Macron* but in the restrictive context of cabotage and ii) lines (including domestic routes) opened up by the enactment of the *Loi Macron*. We selected five new routes (Montpellier–Bordeaux, Montpellier–Lyon, Lyon–Nantes, Lyon–Strasbourg, and Lyon–Paris) and four existing routes (Montpellier–Barcelona, Montpellier–Milano, Lyon–Torino, and Paris–London).

The second selection criterion was linked to the specificity of the spatial organization of most of the French transportation network (i.e., star-shaped around Paris). Given the high territorial coverage of the national road and motorway networks, intercity bus services allow direct province-to-province routes bypassing Paris (e.g., Lyon–Nantes and Lyon–Strasbourg). To highlight any differences between transverse routes and radial routes, we also took into account bus routes incorporating Paris as origin or destination (e.g., Lyon–Paris and Paris–London).

The third selection criterion was related to the distance traveled (i.e., trip duration). This criterion is very important when the consumer faces choices among several transport modes. In our sample, we selected short-haul routes characterized by a distance of around 300 km (Montpellier–Lyon, 303 km; Lyon–Torino, 313 km, and Montpellier–Barcelona, 344 km), medium-haul routes with a distance of around 500 km (Montpellier–Bordeaux, 485 km; Lyon–Strasbourg, 492 km; Lyon–Paris, 466 km, and Paris–London, 470 km), and long-haul routes with a distance of around 650 km (Lyon–Nantes, 684 km and Montpellier–Milano, 643 km).

Our fourth selection criterion was based on the attractiveness of cities connected by bus routes. Here, we used three rankings of European cities (DATAR, 2003; BBSR, 2011; DATAR, 2012).[24] Attractiveness was obtained by determining the geometric mean of the ranking indexes of the origin and destination cities (see Tables 2 and 3–4), following the logic of gravity models

[23] Pursuant to the decisions of December 2, 2015 and May 25, 2016, Arafer is responsible for collecting information on bus operators on a quarterly and annual basis. However, the information collected is at too high aggregate level to conduct analyses in the study.

[24] The DATAR study ranks European cities by using a synthetic indicator that aggregates 15 criteria (population, air traffic, maritime traffic, accessibility, museums, research centers, etc.). The BBSR study uses an approach based on the functions of the various cities. Five criteria are used (political, economic, science, transportation, and culture). Each criterion represents 20% of the composite index. One of the authors of the DATAR (2003), Patricia Cicille, kindly agreed to update the 2003 indicator with data on 2012 (termed the updated DATAR 2012 Index hereafter). This ranking index allows us to define the attractiveness score of each bus route.

widely used in transportation economics (see Cattaneo et al. (2016) for instance). As Table 2 shows, the selected cities have different economic potential, as their annual GDP ranges from EUR 29 billion (Montpellier) to over EUR 600 billion (London). Urban areas also differ in terms of population (from 1.3 million inhabitants for Nantes or Montpellier to 15.1 million for London) and age structure (the share of young adults aged 15–24 ranges from 7.7% of the population for Milano to 18.1% for Montpellier, while the share of seniors aged 65–74 varies from 7% for Bordeaux to 12.1% for Torino). In addition, the geometric mean of the share of young adults aged 15–24 varies significantly by route (from 11.31 to 17.33). There is great heterogeneity in the positioning of each city in the urban hierarchy of European cities, as the ranking indexes vary from 2.8 for Nantes to 100 for London, from 33 for Nantes to 81 for Paris, and from 33 for Montpellier to 100 for Paris for the BBSR 2011 Index, DATAR 2003 Index, and updated DATAR 2012 Index, respectively.

The last selection criterion adopted was to consider bus routes with different conditions of intermodal competition (see Tables 3–4). These tables highlight the wide variety in the bus routes studied. Indeed, there are large differences in the daily frequencies offered by the various transportation modes under the routes considered. For instance, for the routes connecting two cities with high economic potential (comprehended by the geometric mean of the attractiveness indexes of the two connected cities), high daily frequencies are observed, at least for buses and trains. Thus, the Lyon–Paris and Paris–London routes, whose attractiveness indexes are 72.11 and 97.98, respectively, exhibit fierce intermodal competition, with 5.4 and 4.4 bus competitors, 25.19 and 21.14 daily bus frequencies (one-way), and 25.86 and 15.67 daily train frequencies (one-way). This does not hold for the Lyon–Nantes route for which the daily frequencies offered are significantly lower (2.58 for bus and 4.05 for rail).

To sum up, of our nine sample bus routes, four are existing routes in a cabotage context (Montpellier–Barcelona, Montpellier–Milano, Lyon–Torino, and Paris–London), while five are newly opened routes allowed by the *Loi Macron* (Montpellier–Bordeaux, Montpellier–Lyon, Lyon–Nantes, Lyon–Strasbourg, and Lyon–Paris). Finally, our study focuses on a small number of specific and representative bus routes (see Fig. 1 for a map and Tables 3 and 4 for the main characteristics of each route).

	BAR	BDX	LON	LYO	MIL	MTP	NAN	PAR	STR	TOR
GDP (billion €)	132.2	37.9	608.9	84.0	264.9	29.3	35.0	500.6	43.7	74.8
Inhabitants (million)	5.6	1.4	15.1	2.8	8.4	1.3	1.3	12.3	1.6	2.8
Area (10^3 sqm)	5.5	10.0	18.9	8.8	14.6	6.3	8.9	16.9	6.8	10.4
Index of metropolitan functions (BBSR, 2011)	25.8	4.2	100	8.5	28.1	4.0	2.8	97.9	11.5	9.2
Ranking of Metropolitan Areas (DATAR, 2003)	55	36	76	47	57	35	33	81	37	38
Updated Ranking of Metropolitan Areas (DATAR, 2012)	75	39	96	52	72	33	38	100	41	47
Share of young adults aged 15–24	8.9	16.6	9.4	15.8	7.7	18.1	15.9	13.6	16.4	8.2
Share of seniors aged 65–74	9.3	7.0	7.4	7.3	12.0	7.5	7.1	8.0	7.2	12.1

Table 2: Summary of characteristics of cities involved in the study

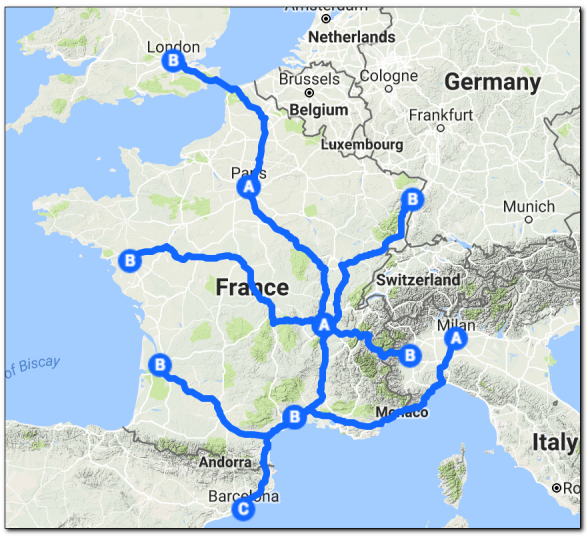

Figure 1: The selected routes in the data set

	MTP–BDX	MTP–LYO	LYO–NAN	LYO–STR	LYO–PAR
Daily Bus Frequency	3.86	4.95	2.58	3.49	25.19
Daily Train Frequency	6.47	15.02	4.05	6.67	25.86
Daily Carpooling Frequency	16.47	30.86	7.49	9.49	52.21
Nb. of bus operators	2.12	4.42	1.88	2.42	5.40
Nb. of train operators	1	1	1	1	1
Nb. of carpooling providers	16.47	30.86	7.49	9.49	52.21
ARPK Bus (€/pkm)	0.032	0.040	0.030	0.028	0.037
ARPK Train (€/pkm)	0.109	0.148	0.135	0.132	0.140
ARPK Carpooling (€/pkm)	0.062	0.060	0.059	0.060	0.058
Bus Travel Time (h.)	7h17	4h40	11h15	7h46	6h55
Train Travel Time (h.)	4h32	1h53	4h35	3h50	2h07
Carpooling Travel Time (h.)	4h56	3h19	6h54	4h51	4h28
Bus Quality Index	4.00	4.33	4.00	5.71	4.80
Distance (km)	484.5	302.8	684.4	492.2	465.6
Geometric Mean of:					
OD–Attractiveness (BBSR, 2011)	4.10	5.83	4.88	9.89	28.85
OD–Attractiveness (DATAR, 2003)	35.50	40.56	39.38	41.70	61.70
OD–Attractiveness (DATAR, 2012)	35.87	41.42	44.45	46.17	72.11
Share of young people aged 15–24	17.33	16.91	15.85	16.10	14.66
Share of seniors aged 65–74	7.25	7.40	7.20	7.25	7.64

Table 3: Average characteristics for the selected domestic routes (one-way)

	MTP–BAR	MTP–MIL	LYO–TOR	PAR-LON
Daily Bus Frequency	45.23	4.05	9.51	21.14
Daily Train Frequency	3.91	4.26	1	15.67
Daily Carpooling Frequency	NS	1.27	3	3.63
Nb. of bus operators	6.05	2.58	4.77	4.40
Nb. of train operators	1	1	1	1
Nb. of carpooling providers	NS	1.27	3	3.63
ARPK Bus (€/pkm)	0.130	0.132	0.092	0.072
ARPK Train (€/pkm)	0.202	0.265	0.199	0.378
ARPK Carpooling (€/pkm)	NS	0.062	0.066	0.083
Bus Travel Time (h.)	6h17	10h59	4h53	8h44
Train Travel Time (h.)	3h01	10h00	3h53	2h26
Carpooling Travel Time (h.)	NS	7h02	3h42	5h23
Bus Quality Index	4.15	4.00	4.50	4.47
Distance (km)	344.2	643.4	313.3	469.7
Geometric Mean of:				
OD–Attractiveness (BBSR, 2011)	10.16	10.60	8.84	98.94
OD–Attractiveness (DATAR, 2003)	43.87	44.67	42.26	78.46
OD–Attractiveness (DATAR, 2012)	49.75	48.74	49.44	97.98
Share of young people aged 15–24	12.69	11.81	11.38	11.31
Share of seniors aged 65–74	8.35	9.49	9.40	7.69

Table 4: Average characteristics for the selected international routes (one-way)

3.2.2 Data collection method

Each week, for each of the studied bus routes, we collected the fares charged by the various bus companies, number of services on offer, number of competitors within the bus sector, and bus travel time. To reduce the number of effects that might disrupt our study of dynamic competition, we noted the characteristics of bus services considered only for direct services with no connection, for one-way tickets purchased three days in advance of the date of departure, which is on Thursday every week. This accounts for the yield management strategies implemented by some bus operators.

We also recorded and computed the same information on travel modes competing with long-distance buses such as train services and carpooling. Data were collected between August 20, 2015 and June 9, 2016, using several comparison and operators' websites.[25] Thus, these data were collected for each of the nine routes studied for 43 successive weeks. Consequently, the final sample consisted of 387 observations. Lastly, we built an average quality index by route. The comparison website www.busradar.fr provides a score for the service quality offered by bus operators.[26] For each week and route, we thus computed the mean quality score weighted by frequency.

[25]Specifically we used `http://www.busradar.fr`, `http://www.comparabus.com`, `http://www.blablacar.fr`, and `http://www.voyages-sncf.com`.

[26]For every bus company, the score ranges from 1 to 6. For instance, the highest score 6 includes a WC on board, free Wi-Fi, large hold luggage, plug-in, large distance between seats (74 cm), and information on delays.

3.2.3 Overall descriptive results

In this subsection, we present the general characteristics of the transport modes included in our study: long-distance bus operators, train services, and carpooling.

We provide the average revenue per passenger-kilometer (ARPK) for each transport mode,[27] distinguishing between domestic and international routes (Fig. 2 and Table 5). Over the study period, the ARPK varies between 0.034 €/pkm and 0.261 €/pkm depending on the transport mode. From a user point of view, the train is clearly the most expensive mode of transport with ARPK values of 0.133 €/pkm and 0.261 €/pkm for domestic and international routes, respectively.

	20.08.15	From 27.08.15 to 14.01.16	From 21.01.16 to 09.06.16	Whole period
ARPK (€/pkm)	**Mean** (SD)	**Mean** (SD)	**Mean** (SD)	**Mean** (SD)
Bus (Domestic)	0.034	0.031	0.037	0.034
	(0.02)	(0.08)	(0.01)	(0.01)
Bus (International)	0.124	0.112	0.101	0.106
	(0.02)	(0.03)	(0.03)	(0.03)
Train (Domestic)	0.134	0.135	0.131	0.133
	(0.02)	(0.02)	(0.02)	(0.02)
Train (International)	0.272	0.261	0.261	0.261
	(0.09)	(0.08)	(0.08)	(0.08)
Carpooling (Domestic)	0.060	0.060	0.059	0.060
	(0.01)	(0.00)	(0.00)	(0.00)
Carpooling (International)	0.066	0.076	0.068	0.072
	(0.01)	(0.01)	(0.01)	(0.01)

Note: SD in brackets stands for standard deviation.

Table 5: Average Revenue per Passenger-Kilometer (ARPK)

It should be emphasized that train travel highlights the large "border effect" since simply crossing a border almost doubles the cost of travel. This border effect is also pronounced for bus travel; the cost of international travel is about three times higher on average compared with domestic routes (0.034 €/pkm and 0.106 €/pkm for domestic and international trips, respectively). This border effect is less pronounced for carpooling, however (0.060 €/pkm and 0.072 €/pkm).

As shown in Table 5 and Fig. 2, in dynamic terms, the ARPK for domestic bus services seems

[27] The average revenue per passenger-kilometer (ARPK) is obtained by applying the following formula,

$$ARPK_j = \frac{\sum_{i=1}^{p} \frac{Frequency_{ij} \times Price_{ij}}{Distance_j}}{\sum_{i=1}^{p} Frequency_{ij}}$$

where j is the considered route, i is the index of the bus operator. We thus have a single indicator for each route, which is the mean of the revenue per kilometer of each operator weighted by the frequency of bus services provided by each bus operator.

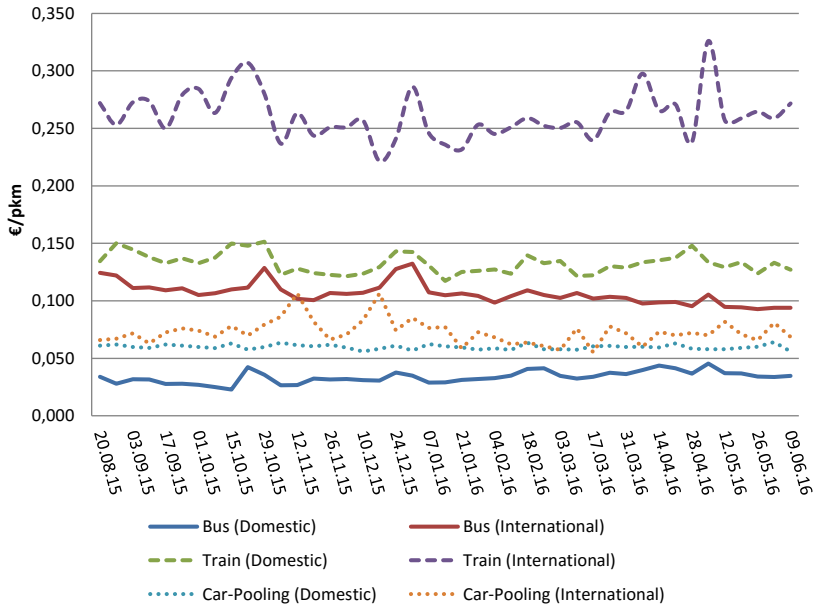

Figure 2: Average revenue per km for bus, train, and carpooling (EUR/pkm)

to increase during the study period, while a significant decrease is recorded for international bus services. Further, the ARPK for domestic carpooling and international train services is stable, while that for domestic train services and international carpooling seems to slightly decrease. Based on these initial results, long-distance bus services and carpooling appear to be close substitutes in France in terms of both fares and transport time. As already discussed, carpooling has been growing strongly in France, particularly in relation to the development of smartphone applications and platform websites such as BlaBlaCar. Hence, the liberalization of the long-distance bus market has increased competition between these two modes.

3.2.4 Dynamics of the intercity bus industry: A route-by-route analysis

Figs. 3 and 4 show the evolution of prices, daily frequencies, number of competitors, and quality index for the nine routes included in the data set. Our analysis starts with the five routes for which regular services were not allowed before the *Loi Macron* (i.e., domestic routes). These plots exhibit a wide variety of prices, quality, and competitive conditions. The Lyon–Paris market seems to reflect all expectations following a process of deregulation: prices are decreasing, with a steady increase in the number of suppliers as well as a substantial increase in daily frequencies and service quality. The ARPK for bus travel is around 0.037 €/pkm. With respect to the Montpellier–Lyon, Lyon–Nantes, and Lyon–Strasbourg routes, prices are gradually rising with a steady increase in the number of suppliers as well as in daily frequencies (apart from Montpellier–Lyon). Moreover, the Montpellier–Bordeaux market appears specific:

despite a steady increase in the number of bus suppliers as well as in daily frequencies, prices remain steady, with only a slight decrease towards the end of the study period.

In summary, nine months after the inception of the *Loi Macron*, the outcomes are mixed. Considering the entry of new competitors and increase in daily frequencies, competition does not seem to have reduced prices (Fig. 3). This applies particularly to the Montpellier–Bordeaux, Montpellier–Lyon, and Lyon–Nantes bus routes. For Lyon–Strasbourg, bus operators have invested in the market by offering very low prices to generate demand for this new service. The first bus operator (Isilines) was joined by FlixBus, after which prices stabilized around 0.028 €/pkm (i.e. around the ARPK for domestic routes). Finally, only Lyon–Paris seems to have achieved all the results expected following a process of liberalization. Hence, the liberalization process has begun to produce some procompetitive effects in this market. However, all these results need to be confirmed, and we must also identify the major differences among domestic routes. Regarding the average quality index for domestic routes, Lyon–Paris, Lyon–Nantes, and Lyon–Strasbourg exhibit an upward trend over the period (Fig. 3). Further, both fares and quality have increased for the last two routes.

We now continue with the four routes for which regular services were allowed before the *Loi Macron* but within the restrictive context of cabotage. Compared with the cabotage situation, the *Loi Macron* allows bus operators to take passengers anywhere in the country, for all bus stops separated by at least 100 km. In addition, recall that the number of passengers in France is not limited to 50% of the total number of passengers as was the case before the *Loi Macron*. Removing this last regulatory constraint should thus improve the load factor for international bus routes, leading to increased margins for bus operators or lower prices for passengers.

The abolition of quantitative restrictions (50% and 100 km) following the liberalization process has not affected the Montpellier–Barcelona and Montpellier–Milano routes, which are highly stable in terms of prices, number of suppliers, and daily frequencies. By contrast, the Lyon–Torino and Paris–London routes have seen price declines as well as a significant increase in daily frequencies and a more limited increase in the number of competitors. In terms of service quality, most international routes have a stable quality index, except for Lyon–Torino for which quality is increasing (Fig. 4).

Finally, in terms of the ARPK, we find significant differences by transportation mode (see Tables 3 and 4). For instance, with regard to newly established (domestic) routes, the ARPK for bus travel ranges from 0.028 €/pkm to 0.040 €/pkm (+43%), while that for carpooling shows small variations (0.060 €/pkm).[28] The ARPK for rail travel exhibits heterogeneity (from 0.109 €/pkm to 0.148 €/pkm) given that high-speed rail services are offered on four of the five routes, suggesting higher quality. Concerning existing (international) routes, large variations in

[28]This stability of the ARPK for carpooling seems quite logical since they do not constitute a price that would correspond to an operator's pricing strategy. They are actually calculated on a cost basis by BlaBlaCar.

the ARPK can be found for all modes (from 0.072 €/pkm to 0.132 €/pkm for bus travel and from 0.199 €/pkm to 0.378 €/pkm for train travel).

3.3 Data analysis

Our database includes data on nine routes over 43 periods. As emphasized by Cameron and Trivedi (2005), if the number of individuals is small and number of time periods is rather large, the slopes may differ across individuals. In this case, panel econometrics is not the most suitable technique. Therefore, to test the above hypotheses, we carry out non-parametric tests on the equality of the means between two subperiods. In addition, principal component analysis (PCA) allows us to introduce more characteristics, especially at the individual level of origin and destination.

3.3.1 Non-parametric tests on the equality of the means

Tests on the equality of the means are carried out to test the expected theoretical results from the deregulation of the French long-distance bus market. We select two subperiods of approximately equal length for the analysis. The first subperiod covers weeks 2–22 (from August 27, 2015 to January 14, 2016, termed Period 1) and the second weeks 23–43 (from January 21, 2016 to June 9, 2016, termed Period 2). The variations between the two allow us to test the above hypotheses. To do so, we use a non-parametric Wilcoxon–Mann–Whitney test since the distributions do not follow a normal distribution. Depending on the hypothesis, we test the equality, inferiority, or superiority of the means in Period 1 with respect to those in Period 2 (see Tables 6 and 7).

We group our route-by-route results into three categories: i) bus routes where the expected results from deregulation occurred, ii) bus routes where mitigated results emerged, and iii) routes where deregulation did not lead to the expected results.

First, the Lyon–Paris and Lyon–Torino routes exhibit the expected results from deregulation. The number of competitors increased (Hypothesis 1 accepted), as did service quality (Hypothesis 3 accepted). Fares decreased on the Lyon–Torino route (Hypothesis 1 accepted) but not on the Lyon–Paris route (Hypothesis 1 rejected). Intermodal competition appears fierce on the Lyon–Paris route since both train and carpooling fares adjusted well to lower levels (Hypothesis 4 accepted).

Of the routes that have mitigated results, the Montpellier–Bordeaux route shows that all hypotheses are accepted except for those based on lower fares (Hypothesis 2 rejected) and the fiercer competition of carpooling (Hypothesis 4 rejected). With respect to the Lyon–Strasbourg route, bus and train fares increased (i.e., showing strategic complementarity). The Lyon–Nantes route exhibits an upward trend in prices (Hypothesis 2 rejected), whereas the number of bus operators and service quality increased (Hypotheses 1 and 3 accepted). Bus fares on the Paris–London route declined (Hypothesis 2 accepted), while the number of competitors increased

(Hypothesis 1 accepted). However, frequency was stable (Hypothesis 3 rejected).

Lastly, the three routes departing from Montpellier (to Milano, Lyon, and Barcelona) experienced effects contrary to those expected from deregulation. Bus fares did not fall (Hypothesis 2 rejected), there was no entry (Hypothesis 1 rejected), and quality did not improve, either by increasing bus frequency or by providing better comfort (Hypothesis 3 rejected).

	T1 (Mean)	**T2** (Mean)	***p*-value***	**Evolution**	**Comments**
Lyon–Nantes route					
ARPK Bus (€/pkm)	0.024	0.038	<0.0001	↗	Hypothesis 2 ⇒ Fares increase
Bus Daily Frequency	1.71	3.52	<0.0001	↗	Hypothesis 3 ⇒ Frequency increases
Bus Competitors	1.33	2.48	<0.0001	↗	Hypothesis 1 ⇒ Competitors increase
Bus Quality	4.16	5.01	<0.0001	↗	Hypothesis 3 ⇒ Quality increases
ARPK Train (€/pkm)	0.132	0.138	0.0340	↗	Hypothesis 4 ⇒ Train fares increase
ARPK Carpooling (€/pkm)	0.059	0.059	0.5028	→	Hypothesis 4 ⇒ Carpooling fares unchanged
Lyon–Strasbourg route					
ARPK Bus (€/pkm)	0.025	0.033	0.0062	↗	Hypothesis 2 ⇒ Fares increase
Bus Daily Frequency	2.71	4.38	<0.0001	↗	Hypothesis 3 ⇒ Frequency increases
Bus Competitors	1.81	3.10	<0.0001	↗	Hypothesis 1 ⇒ Competitors increase
Bus Quality	4.78	5.16	0.5911	→	Hypothesis 3 ⇒ Quality unchanged
ARPK Train (€/pkm)	0.127	0.137	0.0065	↗	Hypothesis 4 ⇒ Train fares increase
ARPK Carpooling (€/pkm)	0.061	0.059	0.1394	→	Hypothesis 4 ⇒ Carpooling fares unchanged
Lyon–Paris route					
ARPK Bus (€/pkm)	0.038	0.036	0.5167	→	Hypothesis 2 ⇒ Fares unchanged
Bus Daily Frequency	19.00	32.14	<0.0001	↗	Hypothesis 3 ⇒ Frequency increases
Bus Competitors	4.62	6.29	<0.001	↗	Hypothesis 1 ⇒ Competitors increase
Bus Quality	4.66	4.81	0.0022	↗	Hypothesis 3 ⇒ Quality increases
ARPK Train (€/pkm)	0.148	0.132	0.0062	↘	Hypothesis 4 ⇒ Train fares decrease
ARPK Carpooling (€/pkm)	0.060	0.057	0.0273	↘	Hypothesis 4 ⇒ Carpooling fares decrease
Montpellier–Bordeaux route					
ARPK Bus (€/pkm)	0.033	0.031	0.2309	→	Hypothesis 2 ⇒ Fares unchanged
Bus Daily Frequency	2.86	4.90	<0.0001	↗	Hypothesis 3 ⇒ Frequency increases
Bus Competitors	1.43	2.86	<0.0001	↗	Hypothesis 1 ⇒ Competitors increase
Bus Quality	4.21	4.75	<0.0001	↗	Hypothesis 3 ⇒ Quality increases
ARPK Train (€/pkm)	0.112	0.106	0.0003	↘	Hypothesis 4 ⇒ Train fares decrease
ARPK Carpooling (€/pkm)	0.060	0.063	0.0406	↗	Hypothesis 4 ⇒ Carpooling fares increase
Montpellier–Lyon route					
ARPK Bus (€/pkm)	0.034	0.046	0.0003	↗	Hypothesis 2 ⇒ Fares increases
Bus Daily Frequency	5.38	4.57	0.0010	↘	Hypothesis 3 ⇒ Frequency decreases
Bus Competitors	4.86	4.00	<0.0001	↘	Hypothesis 1 ⇒ Competitors decreases
Bus Quality	4.33	4.30	0.0250	↘	Hypothesis 3 ⇒ Quality decreases
ARPK Train (€/pkm)	0.155	0.141	0.2461	→	Hypothesis 4 ⇒ Train fares unchanged
ARPK Carpooling (€/pkm)	0.061	0.059	0.1808	→	Hypothesis 4 ⇒ Carpooling fares unchanged

*Wilcoxon-Mann-Whitney tests are used ($\alpha = 0.05$)

Table 6: Results of non-parametric tests (domestic routes)

	T1 (Mean)	T2 (Mean)	p-value*	Evolution	Comments
Lyon–Torino route					
ARPK Bus (€/pkm)	0.101	0.080	<0.0001	↘	Hypothesis 2 ⇒ Fares decrease
Bus Daily Frequency	7.29	11.86	<0.0001	↗	Hypothesis 3 ⇒ Frequency increases
Bus Competitors	4.57	5.00	0.0009	↗	Hypothesis 1 ⇒ Competitors increase
Bus Quality	4.73	5.21	<0.0001	↗	Hypothesis 3 ⇒ Quality increases
ARPK Train (€/pkm)	0.199	0.198	0.3161	→	Hypothesis 4 ⇒ Train fares unchanged
ARPK Carpooling (€/pkm)	0.068	0.064	0.1951	→	Hypothesis 4 ⇒ Carpooling fares unchanged
Montpellier–Barcelona route					
ARPK Bus (€/pkm)	0.131	0.128	0.1740	→	Hypothesis 2 ⇒ Fares unchanged
Bus Daily Frequency	43.71	46.76	0.1122	→	Hypothesis 3 ⇒ Frequency unchanged
Bus Competitors	6.10	5.95	0.1142	→	Hypothesis 1 ⇒ Competitors unchanged
Bus Quality	4.15	4.16	0.9396	→	Hypothesis 3 ⇒ Quality unchanged
ARPK Train (€/pkm)	0.198	0.206	0.1361	→	Hypothesis 4 ⇒ Train fares unchanged
Montpellier–Milano route					
ARPK Bus (€/pkm)	0.133	0.131	0.4644	→	Hypothesis 2 ⇒ Fares unchanged
Bus Daily Frequency	3.76	4.33	0.1374	→	Hypothesis 3 ⇒ Frequency unchanged
Bus Competitors	2.67	2.43	0.3940	→	Hypothesis 1 ⇒ Competitors unchanged
Bus Quality	4.00	4.00	1.0000	→	Hypothesis 3 ⇒ Quality unchanged
ARPK Train (€/pkm)	0.273	0.256	0.696	→	Hypothesis 4 ⇒ Train fares unchanged
ARPK Carpooling (€/pkm)	0.064	0.060	0.6518	→	Hypothesis 4 ⇒ Carpooling fares unchanged
Paris–London route					
ARPK Bus (€/pkm)	0.081	0.063	<0.0001	↘	Hypothesis 2 ⇒ Fares decrease
Bus Daily Frequency	20.90	21.38	0.8343	→	Hypothesis 3 ⇒ Frequency unchanged
Bus Competitors	4.00	4.81	0.0001	↗	Hypothesis 1 ⇒ Competitors increase
Bus Quality	4.47	4.54	0.1048	→	Hypothesis 3 ⇒ Quality unchanged
ARPK Train (€/pkm)	0.376	0.379	0.9898	→	Hypothesis 4 ⇒ Train fares unchanged
ARPK Carpooling (€/pkm)	0.088	0.077	0.0088	↘	Hypothesis 4 ⇒ Carpooling fares decrease

*Wilcoxon-Mann-Whitney tests are used ($\alpha = 0.05$)

Table 7: Results of non-parametric tests (international routes)

3.3.2 Multidimensional analysis

We employ PCA to refine the above analysis by introducing additional variables such as route characteristics. PCA enables us to reduce the data and describe a given multidimensional system by means of a small number of new variables (see, e.g., Johnson and Wichern (2014)).

The active variables in the PCA are all variables in differences (Period 2-Period 1): change in bus service quality (D_QLT), change in bus service frequency (D_FB), change in the number of bus operators (D_NBCB), change in the bus ARPK ($D\_ARPKBUS$), change in the train ARPK (D_ARPKTR), and change in the carpooling ARPK ($D\_ARPKCOV$). In addition, we use four variables to assess differences in route choice: the attractiveness index (A_OD2012), the geometric mean of the share of youth ($Young\_M$), the geometric mean of the share of seniors ($Senior\_M$), and a dummy variable that takes into account whether bus routes have Paris as the origin or destination ($Paris$).

Two significant components accounting for 64.7% of the variance were distinguished for the analyzed data. We first comment on the contribution of the variables to the two principal components (Fig. 5) and then discuss individual routes (Fig. 6). The variables that contribute the most to the first component are $D\_ARPKCOV$ (19%), A_0D2012 (19%), $Young\_M$

(18%), *D_ARPKBUS* (16%), and *Paris* (13%). These five variables account for 85% of the first component and are correctly represented ($\cos^2 > 0.5$).[29] Similarly, four variables contribute the most to the second component (82%): *D_NBCB* (31%), *Senior_M* (21%), *Paris* (16%), and *D_FB* (14%). However, only *D_NBCB* and *Senior_M* are correctly represented on axis 2 ($\cos^2 > 0.5$).

With regard to individual routes, those that contribute the most to the first component are Paris–London (43%), Lyon–Nantes (16%), and Montpellier–Bordeaux (15%). These three bus routes account for 74% of the first component and are correctly represented on axis 1 ($\cos^2 > 0.5$). the routes that contribute the most to the second component are Lyon–Paris (35%) and Montpellier–Milano (27%). These two routes account for 62% of axis 2. They are also correctly represented on axis 2 ($\cos^2 > 0.5$).

This analysis allows us to distinguish at least four groups of origins and destinations:

- *Group #1*: Lyon–Nantes, Lyon–Strasbourg, and Bordeaux–Montpellier are transversal routes that do not pass through Paris and for which the share of young people is relatively high (> 15.8%). These relations are also characterized by lower attractiveness potential (*A_0D2012*), which explains the low level of competition from other modes of transportation (low frequency of trains and carpooling). During the period, the price per kilometer of bus travel remained stable or increased. These routes are operators' main target, namely to create a new market targeting a young population and on which bus operators have aggressive pricing strategies (pricing products low in the beginning and progressively higher and higher thereafter).

- *Group #2*: In contrast to axis 1, we find the Paris–London connection. Characterized by a strong attraction potential, this route showed a decreased bus ARPK during the two subperiods as well as a lower ARPK than its closest competitor (i.e., carpooling). This is a market in which the deregulation of the long-distance bus industry has produced all the expected effects (Hypotheses 1, 2, 3 (partly), and 4), with the exception of frequency (owing to the capacity constraints caused by the channel tunnel or cross-channel ferries).

- *Group #3*: The Lyon–Paris route is highly contested by various bus operators. On this route, the entry of firms is one of the most dynamic; however, the ARPK has thus far remained unchanged.

- *Group #4*: In contrast to axis 2, Montpellier–Milano is a perfect example of a bus route for which the introduction of competition had no effect (at least so far): no entry of any competitor, no price cut, and no increase in frequency.

[29] The complete results of the PCA are available in the Appendix.

The Lyon–Torino, Barcelona–Montpellier, and Montpellier–Lyon bus routes do not fit with any of these four groups for various reasons. First, the expected effects of deregulation are observed for Lyon–Torino. Its benchmark attractiveness and low share of young people (11%) explain the fact that this relationship is not properly represented in the system consisting of the first two principal components. Second, Montpellier–Barcelona could be attached to *Group #4*: the effects of the introduction of competition are virtually null. Third, Montpellier–Lyon could be related to *Group #1*: this is a transversal route with low attractiveness and a young population. Its low position on axis 2 is explained by a decline in bus frequencies and in bus competitors during the study period, which differentiates itself from the other three routes in *Group #1*.

4 Conclusion

The contribution of this study is in assessing the effect of the deregulation of the intercity bus industry in France. We build a unique data set of several bus routes and show that the effects of the liberalization, on average, have been encouraging in terms of fares, new entry, higher frequency, and higher quality. With regard to international routes that used to be under cabotage, we find that relaxing quantitative restrictions has led to the expected results on the Lyon–Torino and Paris–London routes. Second, with regard to domestic routes that have been newly created from the *Loi Macron*, mostly all procompetitive expected variations in variables have been observed, except for fares. Indeed, we show that bus operators used an initial aggressive pricing strategy to induce demand for the new services and then increased fares once customers became accustomed with the service. Noteworthily, a period of consolidation started just after the study period. In June 2016, Ouibus acquired the network of independent bus operators Starshipper. One month after, FlixBus announced the acquisition of the entire continental network of bus connections from the UK competitor Megabus. The race for market share may partially explain this first merger wave. The bus load factor was relatively low for the study period at 40.7% (Autorité de régulation des activités ferroviaires et routières, 2016). The expected profitability was therefore affected, meaning that some rationalization of the streamlined model was needed through the consolidation of connections.

This study is a first step towards a more extensive investigation of the effects of the *Loi Macron* on the intercity bus industry. The nine-month period analyzed for the French market should be extended by future research to capture more of the effects of liberalization. However, this first empirical assessment helps keep track of the deregulation process and provides a base for comparison in the context of future evaluations.

In addition to studying a longer period of time, future research could address other issues. For example, the role and competitive effects linked to access to terminals is worthy of more detailed analysis. For instance, in Madrid, a terminal operator was fined EUR 464,781 for

the anticompetitive abuse of an international bus operator (Anibal case, 2008).[30] Further, bus terminals in France tend to be located close to train stations to avoid offloading. Since the incumbent rail operator SNCF was the only active operator on train stations and has since developed its own bus services brand Ouibus, the threat of anticompetitive practices has been highlighted by the Adlc. New entry should be facilitated if access to terminals remains guaranteed to any active operator (see Autorité de la concurrence (2016)). As former Vice-President of the Adlc, Anne Perrot, argues, the "liberalization of coach transportation will necessitate an adequate network of coach stations to really improve mobility" (Perrot, 2015). Future studies should also pay attention to bus route services covering distances of less than 100 km, which are still regulated but for which Arafer has received a significant number of applications.

[30]Interestingly, for Spain, Alonso-Nuez et al. (2015) show a connection between the deregulation of an industry and an increase in anticompetitive cases in that industry. Their database consists of 261 antitrust cases from 1990 to 2003, and therefore does not cover the deregulation of the long-distance bus services industry. Further, following industry liberalization, non-compliance with legislation might become an issue (e.g., Blayac et al. (2014) in the case of the French funeral market).

References

Aarhaug, J., Fearnley, N., 2016. Deregulation of the Norwegian Long Distance Express Coach Market. Transport Policy 46, 1–6.

Alexandersson, G., Hultén, S., Fearnley, N., Longva, F., 2010. Impact of Regulation on the Performances of Long-distance Transport Services: A Comparison of the Different Approaches in Sweden and Norway. Research in Transportation Economics 29, 212–218.

Alonso-Nuez, M.J., Rosell-Martínez, J., Muñoz-Porcar, A., 2015. Does Deregulation Encourage Anticompetitive Behavior? Journal of Competition Law and Economics 11, 1033–1048.

Autorité de la concurrence, 2014. Avis No. 14-A-05 du 27 février 2014 relatif au fonctionnement concurrentiel du marché du transport interrégional régulier par autocar .

Autorité de la concurrence, 2016. Avis No. 16-A-01 du 15 janvier 2016 concernant un projet d'ordonnance relative aux gares routières et emplacements d'arrêts .

Autorité de régulation des activités ferroviaires et routières, 2015. Décision No. 2015-039 du 21 octobre 2015 portant adoption des lignes directrices relatives à l'instruction des demandes d'interdiction ou de limitation des services routiers sur les liaisons régulières interurbaines par autocar inférieures ou égales à 100 , 1–10.

Autorité de régulation des activités ferroviaires et routières, 2016. Analyse du marché libéralisé des services interurbains par autocar – Bilan du 2e trimestre 2016, september 15, 2016 .

BBSR, 2011. Metropolitan areas in Europe. BBSR-Online-Publikation 01/2011. Eds.: Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) within the Federal Office for Building and Regional Planning (BBR), Bonn, January 2011. .

Beria, P., Laurino, A., Bertolin, A., Grimaldi, R., 2015. Autolinee Statali: Gli Effetti della Riforma. Risultati, Opportunità e Criticità dell'Apertura del Mercato, in: IBE Conference, Rome, Italy.

Blayac, T., Bougette, P., Montet, C., 2014. How Consumer Information Curtails Market Power in the Funeral Industry. European Journal of Law and Economics 37, 421–437.

Burghouwt, G., de Wit, J.G., 2015. In the Wake of Liberalisation: Long-term Developments in the EU Air Transport Market. Transport Policy 43, 104–113.

Cameron, A.C., Trivedi, P.K., 2005. Microeconometrics: Methods and Applications. Cambridge University Press, New York.

Cattaneo, M., Malighetti, P., Paleari, S., Redondi, R., 2016. The Role of the Air Transport Service in Interregional Long-Distance Students' Mobility in Italy. Transportation Research Part A: Policy and Practice 93, 66–82.

Cowie, J., 2002. Acquisition, Efficiency and Scale Economies: An Analysis of the British Bus Industry. Transport Reviews 22, 147–157.

DATAR, 2003. Les villes européennes. Analyse comparative. La Documentation française, Paris.

DATAR, 2012. An Update of "Les villes européennes. Analyse comparative" (data provided by Patricia Cicille). Unpublished work.

Dürr, N.S., Heim, S., Hüschelrath, K., 2016. Deregulation, Competition, and Consolidation: The Case of the German Interurban Bus Industry. Journal of Transport Economics and Policy 50, 164–188.

Dürr, N.S., Hüschelrath, K., 2015. Competition in the German Interurban Bus Industry: A Snapshot Two Years After Liberalization. Competition and Regulation in Network Industries 16, 188–218.

Dürr, N.S., Hüschelrath, K., 2016. Deregulation and the Determinants of Network Access: Evidence from the German Interurban Bus Industry. Applied Economics Letters , 1–6.

Hensher, D.A., 2007. Bus Transport: Economics, Policy and Planning. Elsevier.

Johnson, R., Wichern, D., 2014. Applied Multivariate Statistical Analysis. Pearson Education Limited, Essex. 6 edition.

Kahn, A.E., 1988. The Economics of Regulation: Principles and Institutions. Cambridge University Press.

Knorr, A., Lueg-Arndt, A., 2016. Intercity Bus Deregulation in Germany – Intramodal and Intermodal Effects after Two Years. Research in Transportation Economics .

Morrison, S., Winston, C., 1986. The Economic Effects of Airline Deregulation. Brookings Institution Press.

Nash, C.A., 1993. British Bus Deregulation. Economic Journal 103, 1042–1049.

Perrot, A., 2015. What can economists say about the 'Macron Law'? EurActiv.com .

Robbins, D., White, P., 1986. The Experience of Express Coach Deregulation in Great Britain. Transportation 13, 359–384.

White, P., Robbins, D., 2012. Long-term Development of Express Coach Services in Britain. Research in Transportation Economics 36, 30–38.

A Appendix

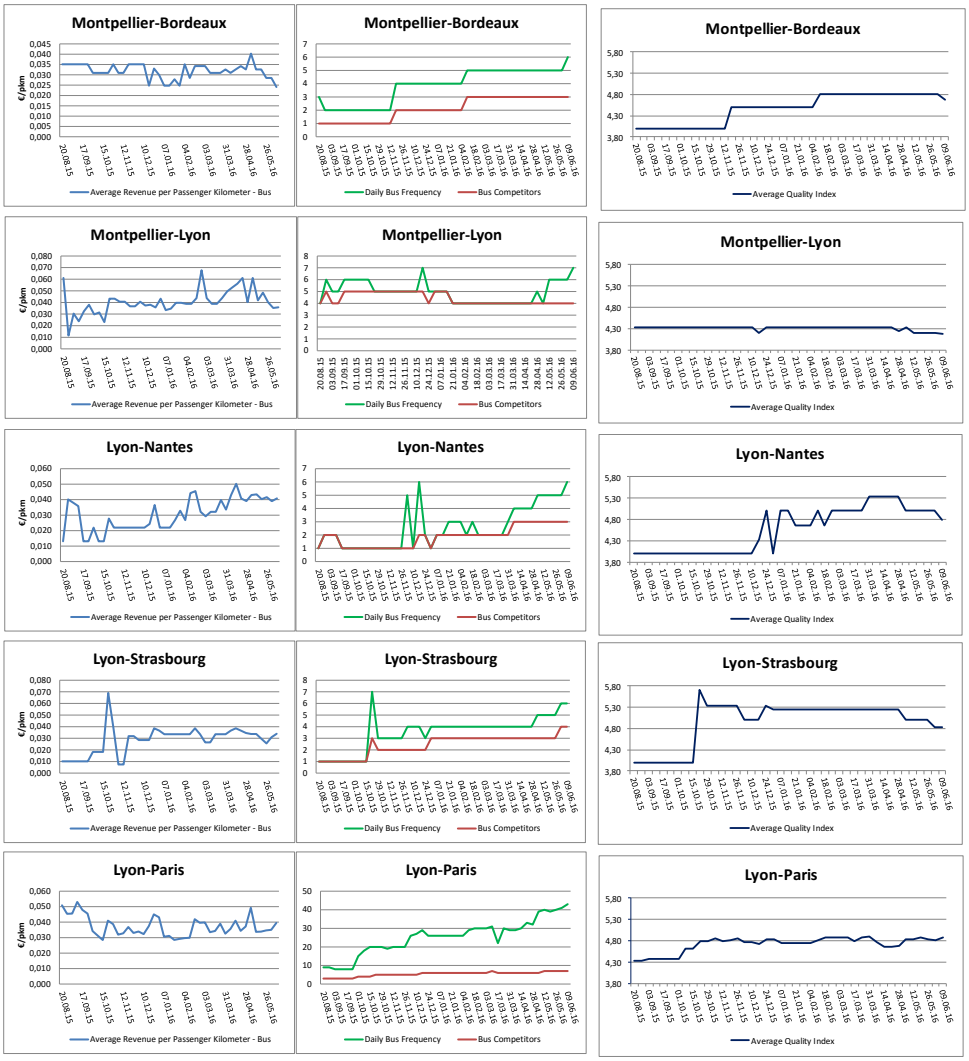

Figure 3: Main characteristics on domestic routes

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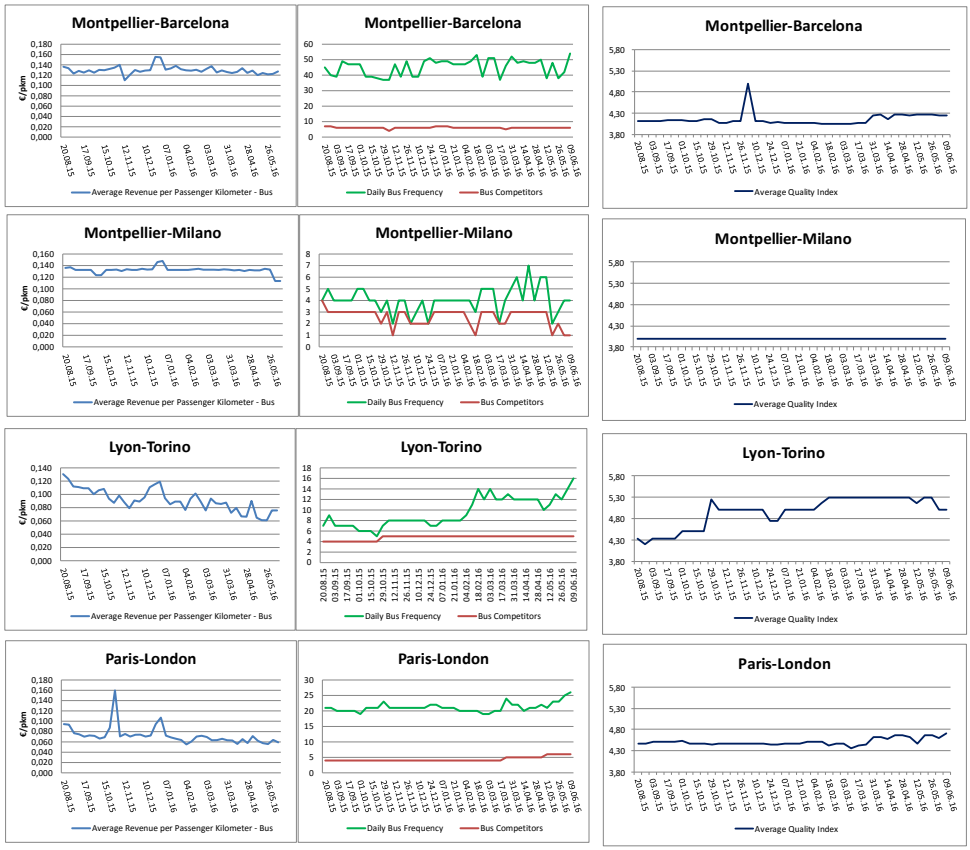


Figure 4: Main characteristics on international routes

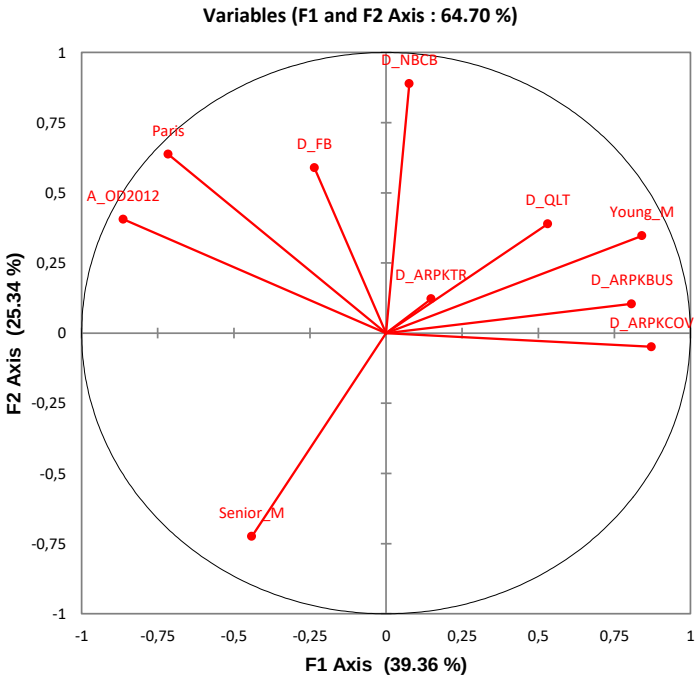


Figure 5: Principal Component Analysis (variables)

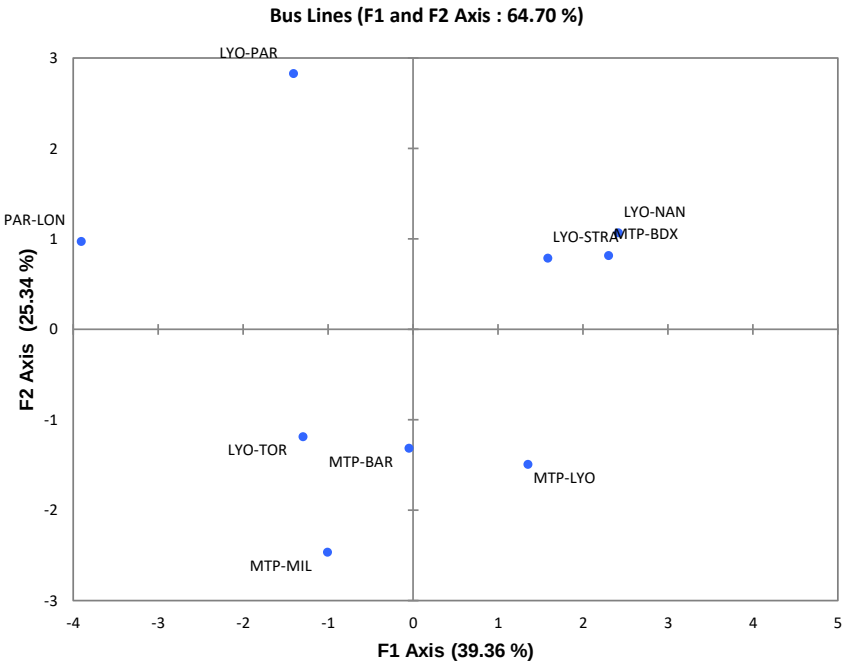


Figure 6: Principal Component Analysis (bus routes)

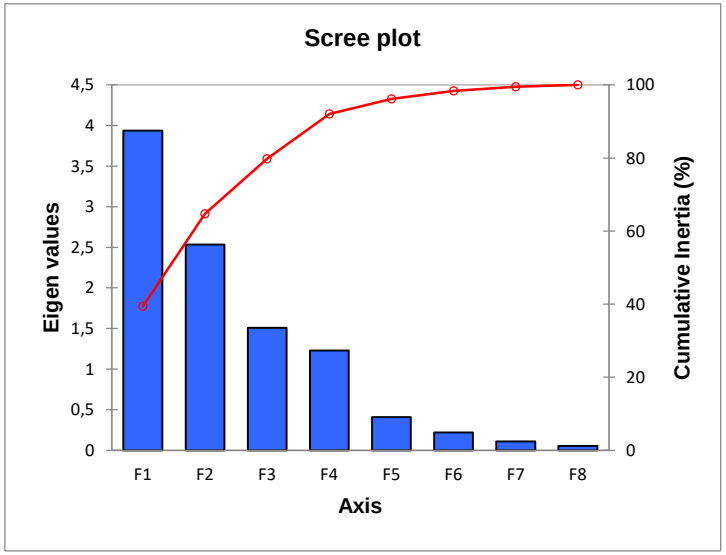
Appendix : PCA – Supplementary material

Correlation Matrix

Variables	Paris	A_OD2012	Senior_M	Young_M	D_QLT	D_FB	D_NBCB	D_ARPKBUS	D_ARPKTR	D_ARPKCOV
Paris	**1**	0.914	-0.249	-0.288	-0.297	0.531	0.407	-0.396	-0.203	-0.664
A_OD2012	0.914	**1**	-0.043	-0.553	-0.355	0.260	0.221	-0.550	0.022	-0.876
Senior_M	-0.249	-0.043	**1**	-0.778	-0.277	-0.075	-0.495	-0.589	-0.181	-0.215
Young_M	-0.288	-0.553	-0.778	**1**	0.359	-0.056	0.254	0.798	-0.063	0.670
D_QLT	-0.297	-0.355	-0.277	0.359	**1**	0.033	0.596	0.221	0.418	0.388
D_FB	0.531	0.260	-0.075	-0.056	0.033	**1**	0.531	-0.192	-0.284	0.076
D_NBCB	0.407	0.221	-0.495	0.254	0.596	0.531	**1**	-0.013	0.228	0.069
D_ARPKBUS	-0.396	-0.550	-0.589	0.798	0.221	-0.192	-0.013	**1**	-0.005	0.595
D_ARPKTR	-0.203	0.022	-0.181	-0.063	0.418	-0.284	0.228	-0.005	**1**	-0.025
D_ARPKCOV	-0.664	-0.876	-0.215	0.670	0.388	0.076	0.069	0.595	-0.025	**1**

Eigen Values

	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
Eigen values	3.94	2.53	1.51	1.23	0.41	0.22	0.11	0.05
Inertia (%)	39.36	25.34	15.08	12.31	4.09	2.20	1.08	0.53
Cumulative Inertia (%)	39.36	64.70	79.78	92.09	96.18	98.39	99.47	100.00



Eigen Vectors

	F1	F2	F3	F4	F5	F6	F7	F8
Paris	-0.361	0.400	-0.195	-0.122	-0.018	0.024	-0.104	0.293
A_OD2012	-0.435	0.255	0.023	-0.255	0.007	0.118	-0.036	0.309
Senior_M	-0.222	-0.455	0.119	0.438	-0.077	0.237	0.274	-0.105
Young_M	0.424	0.218	-0.243	-0.181	-0.130	-0.346	-0.120	-0.405
D_QLT	0.268	0.244	0.472	0.256	-0.512	0.294	-0.456	0.144
D_FB	-0.119	0.370	-0.254	0.563	0.451	0.221	-0.294	-0.331
D_NBCB	0.039	0.559	0.208	0.232	-0.157	-0.120	0.733	-0.071
D_ARPKBUS	0.407	0.065	-0.238	-0.295	0.114	0.778	0.252	0.035
D_ARPKTR	0.075	0.077	0.698	-0.245	0.611	-0.015	-0.040	-0.118
D_ARPKCOV	0.439	-0.031	-0.117	0.334	0.317	-0.236	0.041	0.702

Variables in the new base : coordinates, contributions and squared cosine for the first two principal components

	F1 Axis			F2 Axis		
	Coord.	**CTR**	**Cos²**	**Coord.**	**CTR**	**Cos²**
Paris	-0.716	13.008	**0.512**	0.637	16.034	0.406
A_OD2012	-0.864	18.959	**0.746**	0.406	6.494	0.165
Senior_M	-0.441	4.944	0.195	-0.724	20.709	**0.525**
Young_M	0.841	17.964	**0.707**	0.347	4.746	0.120
D_QLT	0.531	7.167	0.282	0.389	5.969	0.151
D_FB	-0.235	1.407	0.055	0.590	13.725	0.348
D_NBCB	0.077	0.149	0.006	0.889	31.212	**0.791**
D_ARPKBUS	0.807	16.543	**0.651**	0.104	0.427	0.011
D_ARPKTR	0.148	0.557	0.022	0.122	0.590	0.015
D_ARPKCOV	0.872	19.303	**0.760**	-0.049	0.094	0.002

Observations in the new base : coordinates, contributions and squared cosine for the first two principal components

	F1 Axis			F2 Axis		
Observation	**Coord.**	**CTR**	**Cos²**	**Coord.**	**CTR**	**Cos²**
MTP-BDX	2,303	14,968	**0,695**	0,815	2,911	0,087
MTP-BAR	-0,047	0,006	0,001	-1,315	7,586	0,401
MTP-LYO	1,354	5,177	0,180	-1,495	9,804	0,220
MTP-MIL	-1,007	2,862	0,114	-2,465	26,642	**0,681**
LYO-PAR	-1,406	5,580	0,127	2,826	35,020	**0,515**
LYO-TOR	-1,296	4,742	0,195	-1,189	6,202	0,164
LYO-NAN	2,417	16,486	**0,620**	1,067	4,995	0,121
LYO-STRA	1,588	7,121	**0,491**	0,786	2,708	0,120
PAR-LON	-3,905	43,058	**0,753**	0,971	4,132	0,047

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