Delusions of success: Costs and demand of high-speed rail in Italy and Spain

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ABSTRACT

Mismatches between forecasted and actual costs and traffic figures are common in transport investments, especially in large scale ones, and so are delusions of the future demand. High-speed rail projects are often among the worst practices for cost overruns and demand overestimation, even where traffic figures may tell a history of apparent success.

In the paper, we analyse two significant cases of *delusions of success*, namely the Italian and Spanish HSR programmes. The Italian one shows excellent demand performances, but is among the continent's worst cases for construction costs. The Spanish one, recognised worldwide as one of the most successful outcomes of HS policy, is the one where potential demand estimations were systematically neglected, and the planned network appears largely out-of-scale compared to actual traffic. In both cases, the forecasts were not simply biased, as well-known literature on megaproject failures has clearly shown: Italian lines were deliberately designed to increase the cost, and the Spanish network was deliberately planned out-of-scale. By means of the two cases, the paper will show that the core of the problem does not lie in the wrong estimations, but in deliberate choices of overinvestment, overdesign and overquality.

1. Introduction: delusions of success?

Many European countries have undergone, since the end of the XX Century, huge High-Speed Rail (HSR) programmes, following the tracks opened by the the Japanese Shinkansen and French TGV. The former models were adapted in each country, and now the definition of HSR includes quite different models in terms of speed, network integration, type of services and regulatory characteristics (Campos and De Rus, 2009; Perl and Goetz, 2015). Notwithstanding the differences, what looks similar is the fact that, decades after these programmes started, HSR megaprojects appear, often, among the worst practices for cost overruns and demand overestimation, even where traffic figures and network extensions may tell a history of apparent success.

A *success*, which is, ultimately, just a *delusion*.

In fact, the appreciation of customers and of local authorities for high-speed rail services hides, even in the best practices, a number of problems. Large networks may actually change the mobility of regions, but the construction of hundreds, and in some cases thousands, of kilometres of new lines have placed a burden on the budget of many countries. The high costs are, sometimes, amplified by the framework conditions, consisting of environmental mitigations, interconnections, passage through densely built areas, etc., and also by the scarce competition in civil works and by legal frameworks.

A second issue lays in the demand. The success of a HSR system is often measured in terms of induced modal change from air and car. But modal change is not the only goal, and many of these lines remain largely underused. In a few cases, Cost-Benefit Analyses (CBAs)(Preston, 2013; Nash, 2015; Betancor and Llobet, 2015) have been produced ex-ante to make explicit the surplus gains, and to compare them with additional costs with respect to reference solutions, typically conventional rail and air transport. Even rarer are assessments comparing lower-performing solutions, such as improvements of conventional rail, new rolling stock, better signalling and technological management systems, selective doublings, etc.

In this paper, we will address the problems of HSR and megaprojects in general, by studying the Italian and Spanish cases of HSR. The Italian one shows, eight years after completion, excellent demand performances, but is among the continent's worst cases for construction costs. The Spanish one, recognised worldwide as one of the most successful outcomes of HS policy for its huge extension, is the one where potential demand estimations were systematically neglected, and the planned network appears largely out-of-scale compared to actual traffic.

The point we aim to discuss is that, in both cases, the forecasts were not simply *biased*, as literature on megaprojects has clearly shown as usual outcomes (see section 6). Italian lines were *designed* in a way that

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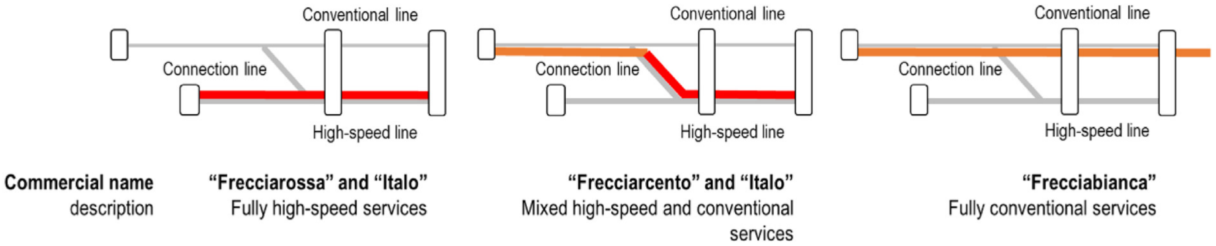

Fig. 1. Schematisation of the mixed high-speed model used in Italy.

increases the cost with respect to European benchmarking. The Spanish network was *planned* out-of-scale with respect to the country's mobility. By means of the two cases, the paper will stress that the core of the problem does not lay in wrong estimations, but in deliberate planning and design choices, which we have summarised into three categories: *overinvestment*, *overdesign* and *overquality*. If choices were such, and not the irrational outcome of a "garbage-can decision-making process" (Cohen et al., 1972; Dente, 2014), it is of some interest to also discuss which are the causes driving the governments to implement them in this way, namely to spend more and to build more than economic ra-tionale would suggest.

The paper is structured as follows. First, we describe the history of Italian and Spanish programmes in sections 2 and 3. In Sections 4 and 5, using available data, we collect traffic and cost figures of the two cases, evidencing where the most relevant failures are. Section 6 discusses the general planning and design choices behind the failures, namely over-investment, overdesign and overquality. Finally, Section 7 tries to find explanations of such choices, mainly in the decision-making process and its actors, rather than in unpredictable pitfalls. Section 8 concludes.

2. The Italian "TAV - Treno Alta Velocità"

2.1. The history of the programme

When it was first conceived, in 1990, the Italian HSR (in Italia "Alta Velocità", or *AV*) was to be a new system, substantially independent from the rest of the network. It aimed at providing faster connections among the cities of Turin, Milan, Bologna, Florence, Rome and Naples (RFI, 2007), which can be considered the "backbone" line of the country. This network should have been built through Project Financing by a new mixed society, called *TAV SpA*, with a 60% portion of private capital to be completely repaid, and the rest owned by the Italian state.

This initial model was soon changed in 1996 and renamed as "Alta Velocità/Alta Capacità" (*High Speed/High Capacity* in Italian, or *AV/AC*). Lines maintained a different voltage[1] from the rest of the network and the same speed, but the introduction of many interconnections with the existing conventional network and the design with lower slopes would allow lines to also host heavy freight trains.

Also, the financial plans changed, and already in 1998, the State had to buy back the entire stock of shares of TAV SpA (13 billion Euros), due to the unavailability of private shareholders to provide entitled capitals (RFI, 2007; Beria and Ponti, 2009).

2.2. Realised and planned network

The construction of the first phase took a decade and was completed in 2009 (See Table 11 in Appendix). The Turin-Salerno axis allows trains to run at 300 km/h, excluding the older Florence-Rome section, the Naples-Salerno (both at 250 km/h) and the urban sections.

Also, the two extremity sections of the Milan – Venice axis were completed (Milan-Brescia and Padua-Venice) and in operation at 200–300 km/h. An upgrade of the Verona-Bologna line opened in 2009, raising its speed to 200 km/h, and a new urban section in Bologna (underground, including a new station under the existing one) opened in June 2013.[2]

While now only the central section of the Milan – Venice is still missing (under construction) to complete the original HS programme, other high-speed lines were added later and their projects are still under discussion (see section 5.1 for more details).

2.3. The supply model adopted

Italian rail infrastructure is, thanks to liberalisation in 2003, open to on-track competition. Different from the other few EU cases, Italian on-track competition is mainly concentrated in the high-speed segment, where a specialised rail company, NTV (Bergantino, 2015; Beria and Grimaldi, 2017), competes with Trenitalia high-speed branded services.

The model adopted in Italy so far is a *mixed high-speed* model, as defined by Campos and De Rus (2009), or a *hybrid network,* as defined by Perl and Goetz (2015). Both companies operate mixed services (conventional and high-speed) using high-speed rolling stock, as schematised in Fig. 1. In particular, some high-speed trains (initially branded *Frecciargento* by Trenitalia and operating at 250 km/h max) run on high-speed lines where available and pass to the conventional infrastructure to serve more origin-destination pairs than those directly connected to HSR infrastructure (e.g., Venice-Rome, Brescia-Rome or Bari-Rome). *Frecciarossa* and *Italo* trains, instead, generally operate on dedicated tracks only (except nodes) and can reach 300 km/h. In ad-dition, conventional services also exist, branded *Frecciabianca* by the incumbent. Fig. 2 and Fig. 3 show daily frequencies of, respectively, Trenitalia and NTV trains using the high-speed infrastructure.

As we will see in the following sections, this model proved to fit the mobility on the North-South axis quite well, where long distance trips between Milan and Rome constitute the larger share. In other contexts, such as the planned Milan – Venice line, a German-like *fully mixed* model would better fit the demand dynamics (Beria and Grimaldi, 2011). In this context, the mobility needs of a wide metropolitan region with middle-sized towns and shorter mobility patterns (less than 200 km), does not rely on the "need for speed" typical of 400–800 km routes.[3]

As already mentioned, interconnections and line characteristics would theoretically allow the use of the high-speed lines by dedicated high-speed freight trains, as foreseen by decision-makers at the moment of planning. However, to date, not a single freight train has used the new lines, and no operator seems to be willing to invest in it.[4]

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[1] High-speed lines operate at 25 kV AC, while the traditional network, including the urban terminals of high-speed lines into cities, operate at 3 kV CC.

[2] The new section allowed a time savings of about 5 min for non-stop services, but its main purpose was to free up capacity in the existing station and urban section for sub-urban and regional services.

[3] Despite its very important touristic role, the *Larger Urban Zone* of Venice had only 493 k inhabitants in 2012, to be compared with the 500 k of Padua, 504 k of Verona and 462 k of Brescia (Eurostat, 2015). In addition, stops are separated by about a 1 h ride or less.

[4] In 2019 a first cargo service should run on the line, using converted old passengers trains to deliver parcels and post.

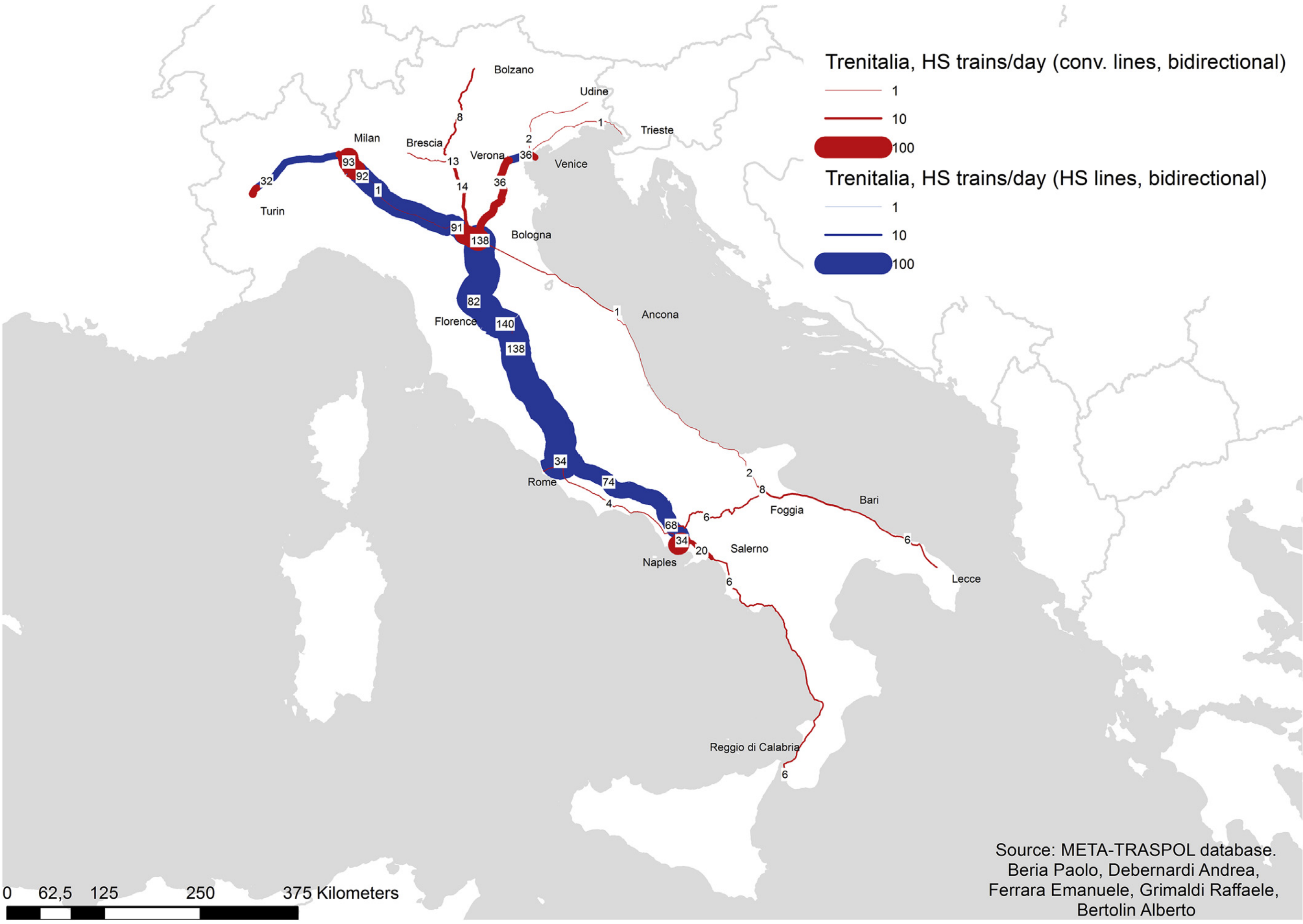

Fig. 2. The network of the incumbent Trenitalia high-speed (*Frecciarossa*) and the mixed high-speed (*Frecciargento*), timetable 2016. In blue is using the high-speed line, and in red, the conventional line. Source: our elaborations on the META-TRASPOL database. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

3. The Spanish "AVE – Alta velocidad Española"

3.1. *The history of the programme*

The first high-speed railway entered into service in 1992, between Madrid and Seville, with intermediate stations at Ciudad Real, Puertollano and Cordoba. However, high-speed rail did not experience additional developments until the year 2000, when it became a centrepiece of infrastructure planning. The central government's programme for high-speed rail since 2000 was based on a goal established by Aznar's government,[5] whose purpose was to connect the country's political and economic capital, Madrid, to all of the provincial capitals by high-speed rail in less than 4 h (Bel, 2011, 2012). This objective has remained stable throughout successive governments (Albalate and Bel, 2015; Betancor and Llobet, 2015).

This goal, and the routes designed by the plan, were not supported by an analysis of mobility needs, but rather by the administrative role of cities as provincial capitals. Not even basic information, such as their population, their travel demand to/from Madrid, and the presence of other modes of transportation already serving the route, determined the choice to invest or not. For this reason, the program can hardly be understood as a transportation policy, especially because the design did not consider the potential of passenger volumes and time savings in respect to the large investment efforts, or its interaction with other modes of transportation already in place.

Because the development of the high-speed rail network has been the main protagonist of transportation policy since 2000 and the centrepiece of infrastructure planning and investment, Spain has rapidly become the European leader of high-speed rail infrastructure in terms of the length of its network (Albalate et al., 2015a). Moreover, Spain ranks second in the world today, only behind China.

3.2. *Realised and planned network*

After the Madrid – Seville, the second stage of the high-speed rail development started with the Madrid-Zaragoza route in 2003, as the first section of the future Madrid-Barcelona-France corridor (Northeastern Corridor) that would arrive to Barcelona in 2008 and to France, with direct services, in 2013 (see Table 12 in Appendix). Currently, after a period of dynamic development and public investment, there are 4 high-speed rail corridors in operation connecting Madrid to the French Border, to Andalusia, to the Mediterranean coast (Levante) and to Valladolid, Palencia and León (Northern corridor). Also, the first phase of the Madrid-Galicia is already in service in both extremes (A Coruña-Ourense and Olmedo-Zamora), waiting for the continuation between Ourense and Zamora.

As a result, Spain enjoys a high-speed rail network of more than 2700 km. Further works are being carried out to complete new lines or to extend current links, in some cases using a mix of new standard

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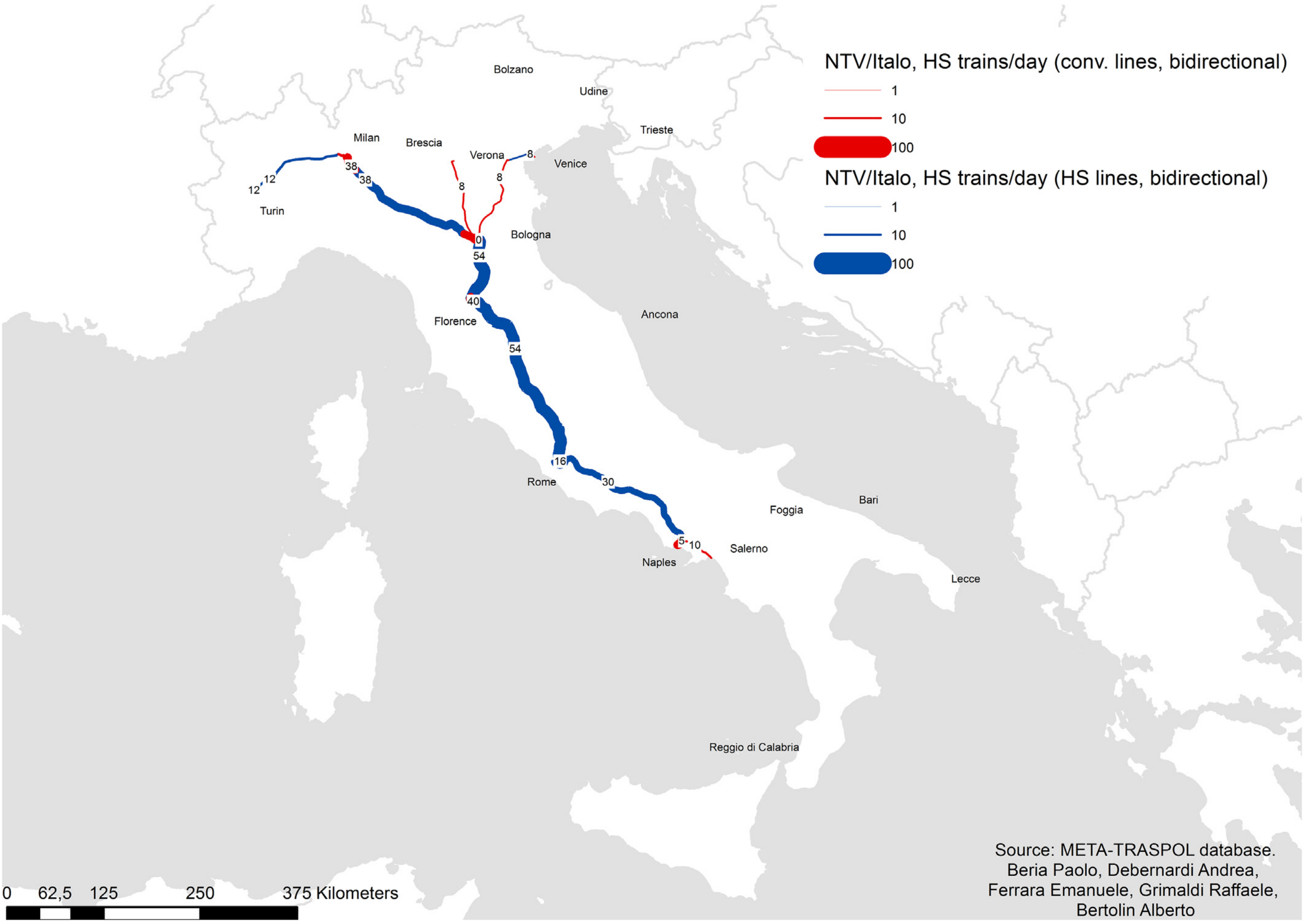
[5] Investiture debate for the 2000–2004 legislation (*Diario de Sesiones del Congreso*, 2000, n° 2, (April 25), p. 29).



Source: META-TRASPOL database.
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Fig. 3. The network of the competitor NTV (*Italo*). In blue is using the high-speed line, and in red is the conventional line, timetable 2016. Source: our elaborations on the META-TRASPOL database. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

gauge and upgraded sections, to be used by specific interoperable rolling stock.[6] Plans include extensions north to Oviedo, Ourense, Burgos and to the province capitals of the Basque country, and south to Granada and Cadiz; a link to Extremadura is also being considered.

3.3. *The supply model adopted*

From the variety of possible combinations of infrastructure features, Spain opted for separate tracks disconnected from the existing conventional infrastructure. This decision meant greater spending on construction, particularly in the expropriation of land in urban areas. However, it also provided services at higher speeds, promoting the competitiveness of this mode of transportation in respect to other modes, particularly air transportation. Most lines are designed to achieve maximum speeds between 300 and 350 km/h. In addition, the modernisation of some conventional lines allowed high-speed trains to operate at 200–220 km/h.

Differently than Italy, Spain opted for a high-speed rail infrastructure with a clear orientation towards passengers (Albalate and Bel, 2011). This choice left freight traffic mainly to the conventional network, with the relevant exception of the line connecting the French border. Another characteristic of the model chosen is that Spain has used foreign technology, mainly French and German (Vickerman, 1997). However, agreements included in return that at least 80% of material manufacture had to be produced in Spain.

Similarly to Italy, also the Spanish network is used by full high-speed services (named AVE, which is the only real HS service in Spain) and by mixed services partially running on conventional lines (such as Alvia, up to 250 km/h on HSR lines with trains for long-distance ser-vices that combine high-speed lines with conventional lines, thanks to the use of variable-width trains) as in Fig. 4. This allows for extending the benefits of the fast tracks to peripheral cities, before the new line is built or in substitution of it. Quite unique in Europe, Spain also operates fast regional services (Avant, up to 250 km/h), typically from Madrid to the nearest cities. These services are subsidised as medium distance services, and they allow better use of the available and otherwise un-used capacity of the lines (Betancor and Llobet, 2015). Avant comple-ments services in frequent and short-haul journeys, which do not have services dedicated to long distance, but have tariffs, schedules and frequencies adapted to daily round trips. The Avant services are re-stricted to regional traffic, where the greatest distance covered of about 200 km. Altaria trains could use the HS network, but to do so, they would require changing the locomotive, and therefore are mainly used on conventional lines only. Spanish network is represented in Fig. 5.

4. Demand figures

4.1. *Italy*

The initial figures of the Italian HS were not particularly impressive, with actual patronage well below the expectations (Beria and Grimaldi, 2011) and consequently in line with literature on demand

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[6] In terms of gauge and electric power supply.

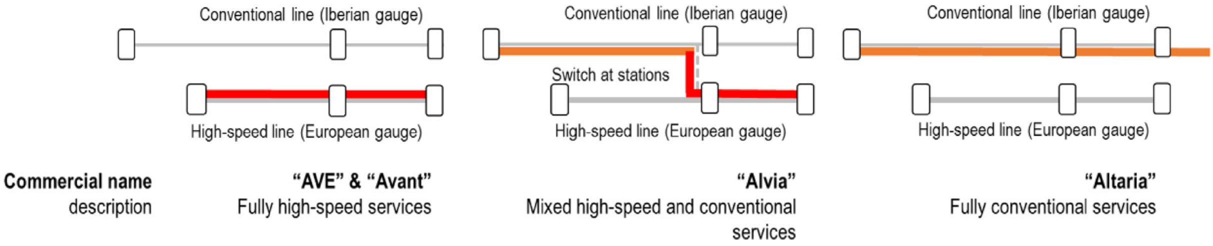
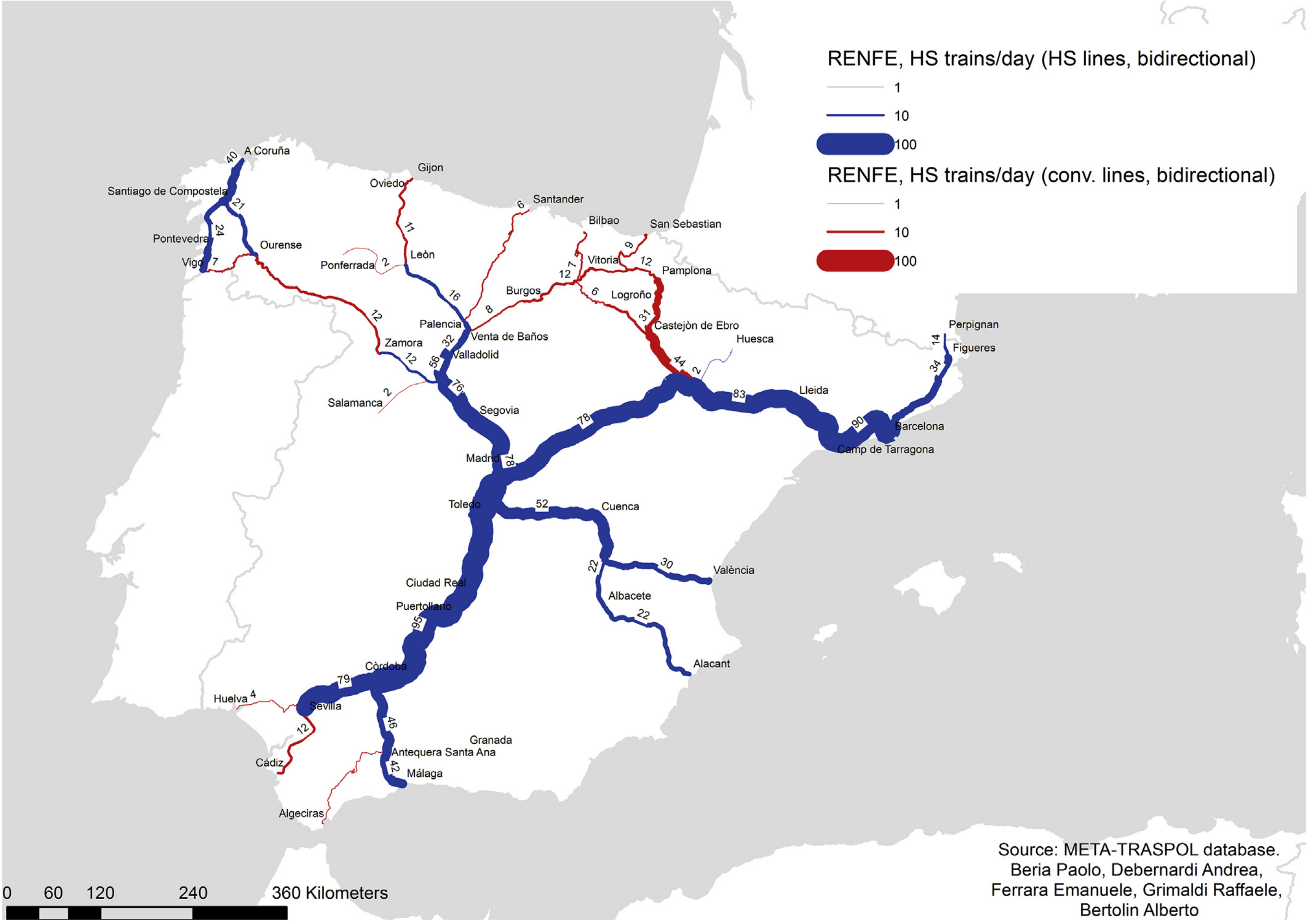


Fig. 4. Schematisation of the high-speed model used in Spain.



Source: META-TRASPOL database.
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Fig. 5. The network of RENFE. In blue is using the high-speed line, and in red is the conventional line, timetable 2016. Source: our elaborations on European Rail Timetable. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

overestimation (Flyvbjerg et al., 2003). Things changed, as we will document, and overall, Trenitalia served 45 Million passengers on its commercial long-distance services in 2014, even if no figures on single types of service, in particular high-speed ones, are available. NTV operates in the HS segment only and declared 6.6 Million passengers in 2014 and 12.8 in 2017. Previous works estimated the 2010 patronage on lines' segments, based on supply levels and some punctual figures (Beria and Grimaldi, 2011). A more recent work (Dell'Alba and Velardi, 2015) provides figures with a similar detail for 2013. Table 1 collects the results of those unofficial disaggregated estimates for comparison. Values refer to the "core area" as defined in Dell'Alba and Velardi, 2015, which includes trains of the Turin – Salerno axis and the Bologna – Venice branch only, and both competitors Trenitalia and NTV. This classification has recently lost meaning as high-speed services are progressively extended out of the high-speed network.

Table 1
Estimation of Million passengers travelling on line sections. Sources: 2013 figures, our interpretation of Dell'Alba and Velardi (2015); 2010 figures (rounded central value), Beria and Grimaldi (2011).

Line section	2010 Trenitalia	2013 Trenitalia + NTV	Increase
Torino - Milano	1.5	4	+167%
Milano - Bologna	6.5	13	+100%
Bologna - Firenze	11	18	+64%
Firenze - Roma	9.5	17.5	+84%
Roma - Napoli	3	7.5	+150%

The central sections of the Italian network, from Bologna to Rome, are the ones with the highest number of passengers, around 18 million per year already in 2013. This section collects the three northern branches of HS services from Turin/Milan (the most important, with 13 Mpax), from Verona and from Venice. The extreme segments, Milan –

Table 2

Italian aggregate supply and demand value of high-speed services.

		2010	2013	2015	CAGR 2013-15
Million passengers HS	Trenitalia	18.7*	42.0	50.0	9.11%
	NTV	–	6.2	9.1	21.15%
	Total		48.2	59.1	10.73%
Million passengers·km HS**	Trenitalia	11,610	12,460	15,120	10.16%
	NTV	–	2,630	3,150	9.44%
	Total		15,090	18,270	10.03%
Million pax·km/km of lines**	TOTAL	12.1	15.7	19.0	
Million trains·km HS	Trenitalia	25.9***	53.9	53.4	−0.47%
	NTV	–	12	14	8.01%
	Total		65.9	67.4	1.13%
Load factor (average pax/train)****	Trenitalia	n.a.	231.2	283.1	
	NTV	n.a.	219.2	225.0	

Sources: * our elaboration on Beria and Grimaldi (2011), core sections only. ** Ministry of Economy, DEF 2017. The figure includes also mixed-HS services *** "Da zero a Italo" brochure, core sections only. **** The average pax/train is a proxy of load factor. The specific number of seats varies train by train according to train operators' optimization and is not available. Where not indicated, the sources are press releases or balances of the companies.

Table 3

Spanish aggregate supply and demand value of high-speed services.

	2008	2013	2015	CAGR 2013-15
Million passenger	16.3 *	21.3 *	26.1 *	+7.0%
Million passengers·km	5,483*	8,154 *	10,027 *	+9.9%
Million pax·km/km of lines	2.3	3.6	3.9	
Million Trains·km	32.03**	45.03**	n.a.	
Load factor (average pax/train)***	171.2	181.1	n.a.	

* Ministry of transportation. We consider only the pure AVE trains - Commercial, which circulate integrally by UIC width. ** Tribunal de Cuentas (2015). *** The average pax/train is a proxy of load factor. The specific number of seats varies train by train according to train operators' optimization and is not available.

Table 4

Total volume of passengers in high-speed rail and long distance services.

Main O-D connections (> 1 million passengers)	2012	2013
Madrid-Sevilla	2.1	n.a.
Madrid-Barcelona	2.7	3.1
Madrid-Valencia	1.8	1.9
Madrid-Málaga	1.4	1.3
Madrid-Zaragoza	1.1	1.2
Madrid-Valladolid	1.1	1.2

Source: Ferropedia.

Turin and Rome – Naples, are the less crowded.

The trend of patronage is more impressive than absolute values. In just two years, the central segments increased between 60 and 100%, and the extreme ones more than doubled. The explanation is twofold. On one side, part of the increase is due to the increasing maturity of the system (fully opened in 2009). On the other, a significant role has been played by the competition developed since 2012 (Bergantino et al., 2015; Beria and Grimaldi, 2017) thanks to the entrance of NTV, providing more capacity and forcing Trenitalia to both reduce significantly the cheapest and the average fares and increase the quality (Bergantino et al., 2015; Beria et al., 2016). This allowed passengers with less willingness to pay to access the system and overall increased the number of trips.

An indirect demonstration of the capability of HS to attract new passengers comes not only from the severe financial problems of Alitalia, whose Linate – Fiumicino route has long been a never-ending source of profits, but also from the entry and sudden exit of low cost carriers (easyJet in particular) from a route which now guarantees lower yields.[7]

Table 2 gives evidence not only that the total passengers increased (+11% on average in the last years), but that the distance travelled increased too (+10%). This let us infer that the entry of NTV (together with the maturity of Trenitalia's offer) did reduce the Trenitalia share, but not its passengers, as total demand increased significantly and even more than the increase of supply. Even if we have no evidence of that,[8] we can expect a decrease in the margin of the train companies, all in favour of travellers. With all the limits of this kind of aggregate indicators, the density of passengers per km of lines also dramatically increased, from 12 to 19 Mpax·km/km from 2010.

In conclusion, Italian figures are more impressive for the trend and for its causes, than for the absolute number of passengers travelled, which is significant, but remains below the top densely used lines in Europe (Albalate and Bel, 2015).

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[7] easyJet press release states that, given Linate's slots, other routes are more profitable than Fiumicino http://www.ilsole24ore.com/art/notizie/2015-03-26/easyjet-si-ritira-rotta-milano-linate-roma-fiumicino-114517.shtml?uuid=ABTHMlFD.

[8] The balance sheet of Trenitalia is not disaggregated enough to allow separate financial performances of high-speed services with respect to conventional ones.

Table 5
Construction costs per line section and travel times, Italy (our elaboration on RFI, 2007; internal documents).

Section	Investment cost (in current terms)	Cost per km[a]	Line description	Travel time	Travel time
	M€	M€/km		1999	2011
Turin – Milan	7653	54	Plain line in agricultural area, along the highway	01:35	01:03
Milan – Bologna	7043	31	Plain line in agricultural area, along the highway	01:42	01:05
Bologna – Florence	5720	68	Semi-continuous tunnel in complex rock	00:50	00:36
Rome – Naples	5905	24	Plain/hilly line in agricultural area	01:45	01:10

[a] Including interconnections to conventional lines.

4.2. *Spain*

HSR passengers (both medium- and long-distance) increased from 8.2 million in 2006 to 26.1 in 2015, according to figures by the Ministry of Transportation. This figure only represented the 6% of total rail passengers in the country in 2015 (it was 2% in 2006). Regarding HSR passengers-km, they grew from 2.3 billion in 2006 to 9.5 in 2015.

Information regarding main origin-destination connections is displayed in Table 3, where we can observe that the main link, Madrid-Barcelona, only received 3 million passengers per year. All the rest of the routes are far from reaching this figure. Table 4 also reports the number of trains-km. There were 45 million trains-km offered in 2013, the last available year.

5. Construction costs

5.1. *Italy*

According to initial plans, the costs of the Turin-Salerno axis was expected to be 10.7 billion€ in 1992. In 2006, before the conclusion of the works, it rose to 32.0 billion€, meaning costs doubled in real terms (RFI, 2007).[9] But cost escalation is not the main problem, in contrast to literature evidence (Flyvbjerg et al., 2003). In fact, the cost per km reached, on average, 32 M€/km, much higher than in any comparable case in Europe (Campos and De Rus, 2009 and Nash, 2015), also considering the different orographic and land use characteristics.[10]

As already mentioned earlier (section 2.1), the Italian high-speed programme was supposed to be largely privately-funded. This expectation faded away as soon as it became clear that no financial return was possible from the investment, and no private investor was willing to invest its equity in the "enterprise". The State tried to keep the concessionaire TAV SpA "private" by buying 13 billion Euros of shares through its investment fund *Infrastrutture SpA*, but this operation was recognised as a trick by Eurostat, and the State had to buy back all shares. TAV SpA became fully public and was merged with RFI, the national infrastructure manager.

But the investments in Italian HS did not end with TAV SpA. According to 2016 national planning (MEF, 2016), the extension of the HS network is foreseen from Milan to Venice (11 b€, of which 2 b€ is completed from Milan to Brescia) and from Naples to Bari (2,6 b€). In addition, three important alpine lines for mixed high-speed and freight services are under construction, for a total of 13.2 b€ (Italian sections only). However, some of these investments are not yet started, and in 2017, an important change of direction has been seen in official documents (MEF, 2017), foreseeing cost cuts thanks to a radical redefinition of the projects.

5.2. *Spain*

The Strategic Plan for Infrastructures and Transportation (PEIT) foresaw 43.7% of spending in the period 2005–2020 to be dedicated to interurban rail. Within the railway mode, high-speed rail was planned to receive three-quarters of such spending.

In effect, the investment in the extension of the AVE has been very high. The gross cost of the first line, Madrid-Seville, was $3.5 billion in 1992 (De Rus and Inglada, 1993, p. 37), amounting to more than $6 billion in 2010 terms (Albalate and Bel, 2012b). A recent report of the Accounting Court (Tribunal de Cuentas, 2015) indicated that ADIF had spent, by the end of 2013, about 56.5 billion euro, with 44.2 billion euro in investments already realised. Because these figures do not in-clude the spending of the lines built before 2007,[11] we can estimate that the volume of spending made on AVE activities up until the end of 2013 was well over 60 billion (Contracted) and close to 50 billion (executed), including lines in service and lines under construction.

Regarding specific lines, Table 6 details the costs at corridor level for those opened by 2013, in constant euro at that year, which allows for a direct comparison (Betancor and Llobet, 2015). As can be ob-served, Spanish construction costs per km is relatively cheaper than the construction costs in other experiences that are comparable. Albalate and Bel (2015) compare recent high-speed rail projects in the world and find that Spain, only after China, presents the lowest average cost per km within a group of countries that includes other more expensive experiences, such as France, Germany, Japan, Korea, Taiwan and Italy. Nonetheless, Spain did not escape from experiencing large overcosts in respect to forecasts. For instance, the route between Madrid and Barcelona suffered a 31% overcost (Tribunal de Cuentas, 2013), lower than the overcost of the first line between Madrid and Seville, which was at least 70% larger.[12]

Despite the economic crisis and its impact on budget constraints, the Spanish government has not paralyzed its project of network extension in the last years. The aggregate amount of annual investments has decreased, but its share of the total investments in railways infrastructure has kept a similar path, representing about 70% of total investments. On available figures, we estimate total investments to be close to 30 billion euro in the period 2009–2016.[13]

ADIF investments were financed mainly with increasing bank debt, together with contributions from the State and collections of European funds (Albalate and Bel, 2011). Indeed, many of these lines enjoyed the assistance of the different European funds that were available for infrastructure projects and that Spain devoted to this specific programme.

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[9] 10.7 billion Euro$_{1994}$ is equal to 15.5 billion Euro$_{2006}$ (RFI, 2007).

[10] The cost of lines in France was 10 M€/km and 9 M€/km in Spain.

[11] The report does not include previous lines because ADIF was created in 2005.

[12] These figures were provided by the Ministry of Transportation, Francisco Álvarez Cascos (PP), in the Congress in 2003, in order to compare the increasing overcost of the Madrid-Barcelona line to the larger overcost of the Madrid-Sevilla project managed during the mandate of the opposition (PSOE). See http://www.elperiodicodearagon.com/noticias/temadia/ave-ya-acumula-sobrecoste-354-millones_45943.html (in Spanish). Last retrieved 22/07/2017.

[13] The only public information is on planned investments and not the executed ones (information regarding realised investments is aggregated within the railway category, making it impossible to distinguish the part of it devoted to high-speed rail lines). The planned investment is over 35 billion euro. We know from the report of the Accounting Court (Tribunal de Cuentas, 2015) that the executed investments in 2013 in high-speed rail were 85% of the planned investments. Assuming this figure as a constant percentage, it would leave accumulated investments in the period of 2009–2016 close to 30 billion euro.

The amount of this funding sums up to 11.4 billion, covering around 20% of total investments.

6. The forms of delusion

Literature on megaprojects generally refers to two problems: optimism bias in the demand estimations and cost overrun with respect to investment cost forecasts. The well-known seminal work of Flyvbjerg et al. (2003) documented how, *systematically,* forecasts for megaprojects were wrong, underestimating the costs and overestimating the demand, both facts ending with an artificially high benefit to the cost ratio of selected projects. Furthermore, they stress that these biases are *deliberate* (Flyvbjerg, 2007a; Flyvbjerg et al., 2002), actively pushing decisions in the direction of building unjustified infrastructure.

Regarding cost forecasting deviations, one explanation is that the actors involved justify their deliberate deviations as part of a strategy aimed at keeping the works' cost low to save public money (see Merewitz, 1973, Wachs, 1990), even if this ultimately does not happen. Nonetheless, there is another explanation in terms of public interest. In the words of Flyvbjerg et al. (2009: 31) there is "*the not uncommon situation where project promoters believe their venture will benefit society and posterity. They feel that they should do anything possible to make the project happen, including cooking forecasts of costs and benefits.*" Demand forecasting deviations are even more common, also because future travel behaviour is even more difficult to forecast with respect to con-struction costs. However, also in this case, authors verify that errors are not normally distributed, suggesting that part of the bias is voluntarily introduced. Interestingly, rail projects seem to be more inaccurate (Van Wee, 2007). Even more interestingly, only for roads, whose impact is hardly accepted by citizens, demand appears systematically *underestimated* (Næss et al., 2006; Flyvbjerg, 2007b; Nicolaisen and Driscoll, 2014). This reinforces the hypothesis of strategic misrepresentation, even if more recent works suggest that this is not the only explanation (Makovšek, 2014; Love et al., 2015).

Other characteristics of the megaproject are also drivers of deviations. On the one hand, Cantarelli (2009) finds that overruns in the Netherlands were positively correlated with the size of the project. This result suggests that cost overruns are a major problem in large projects such as HSR, while small projects perform better. On the other hand, Flyvbjerg et al. (2006) show that more than 9 out of 10 rail projects had demand overestimated, with 72% of all rail projects presenting deviations by more than two thirds, with a mean overestimation of 105%. 84% of the rail projects had actual traffic more than 20% below forecasts. Locatelli et al. (2017), among other drivers of delays and cost overruns, find that low population densities are associated with lower delay probability. They also find that if the project is a railway, it is likely to be late and overbudget, especially in the presence of tunnels and underground structures.

However, not all megaprojects have shown both of these problems (cost overruns and demand biases) and may thus give the impression of a success, in terms of passengers, quality and even cost containment. This is the case with most of HS lines, appreciated by users, supported by ministries and requested by local politicians. On the other side, however, it is doubtless that HS programmes are extremely expensive, serve a limited share of national demand and, overall, show low ben-efit/cost ratios. This means that, ex-post, realised schemes may appear unjustifiable from an economic or environmental viewpoint, but are supported anyway by stakeholders.

Consequently, we propose a more structured approach to study megaprojects, going beyond formal mismatches (that forecasts are wrong and/or falsified), and questioning also about substantial planning and design choices, especially when they do not match with the potential demand. In this sense, the two cases presented before represent useful examples of this need to extend attention beyond *formal* aspects into *substantial* ones. The Italian high-speed did not present a high cost-overrun once construction started, but it did cost, *from the beginning,* much more than any other

Table 6

Construction costs per high-speed rail corridor (constant €$_{2013}$) and travel time, Spain. Source: Betancor and Llobet (2015).

Section	Investment cost (in current terms)	Cost per km	Line description	Travel time	Travel time
	M€	M€/km		1999	2011
Madrid-Andalucía[a]	5584	8.9	Plain line in agricultural area, along the highway (but Despeñaperros passage)	6:30	2.25
Madrid-Barcelona[b]	7541	10.8	Plain/hilly line in agricultural area	5:20	2:30
Madrid-Levante[c]	5882	9.2	Plain line in agricultural area, along the highway	3:25	1:35
Madrid-Valladolid	3871	21.5	Semi-continuous tunnel in complex rock half way/Plain line in agricultural areas half way	3:13	0:58

For travel times, we take the fastest trip in the section. The destination city in Andalucía is Málaga, and in Levante it is Valencia.

[a] Includes Madrid-Sevilla and Córdoba-Málaga. Excludes La Sagra-Toledo.

[b] Includes Madrid-Lleida-Barcelona and Zaragoza-Huesca.

[c] Includes Madrid-Valencia and Bifurcation Albacete-Alicante.

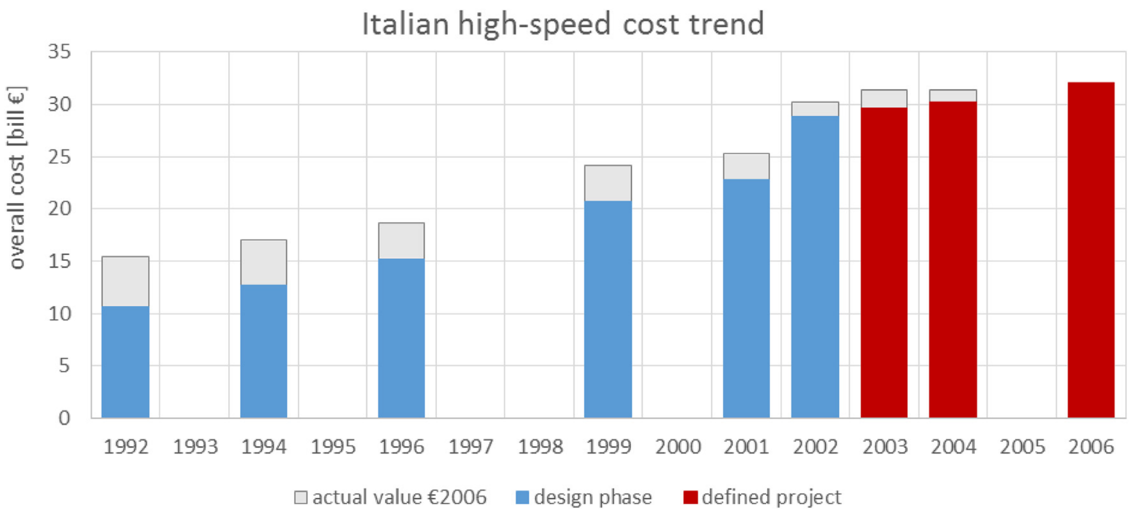

Fig. 6. Trend of construction costs of Italian HSR. Real and actual values. Source: adapted from Corte dei Conti, 2009.

Table 7
Use and intensity of use of high-speed rail networks, by country (2012 and 2015).

Country	Passenger·Km 2012 (Billions)	Passenger·km per Km 2012 (Billion pass·km/ thousand Km)	Passenger·Km 2015 (Billions)	Passenger·km per Km 2015 (Billion pass·km/ thousand Km)
France	51.09	25.1	49.98	24.5
Germany	24.75	24.4	25.28	17.1
Italy	12.79	13.9	18.26	18.6
Spain	11.18	4.5	14.13	4.9

Sources: European Commission (2014). EU Statistical Notebook 2017 (computation based on tables 2.3.8 and 2.5.4) EU Transport in figures-Statistical pocketbook, except for Italy, 2015 (MEF, 2017). Note these demand figures include all traffic using high-speed rail lines.

comparable infrastructure in Europe, because of technical and organisational choices adopted. Spanish HS demand forecasts – when not missing – were not optimistically biased, but were *unconnected with actual mobility requirements* and, consequently, lines are often underutilised.[14]

We classify the problems behind such *delusions of success* of HSR project into three forms, namely:

(the risk of) overdesign;
(the threat of) overinvestment;
(the temptation of) overquality.

6.1. Overdesign

The first issue – not directly connected with cost-overruns – is *overdesign*: an infrastructure could be designed in a redundant way, adopting excessive design parameters and consequently costing more than a similarly performing one, without bringing real benefits.

The Italian high-speed line is worldwide known as a case of extra-ordinary high construction costs (see Table 5 vs. the Spanish ones in Table 6). However, this high cost is not due to an increase during con-struction, for example due to unexpected factors or on-going modifications. The infrastructure manager RFI, in a public consultation to the Parliament in 2007 (and reported by Corte dei Conti, 2009; page 19), reports the in-crease in the cost of the line between the initial design phase, when the technical characteristics were not fully defined, and the final phase of construction, with all elements fixed.

As visible in Fig. 6, the larger cost increase occurred in the initial phase, and is due to the change of project characteristics and the construction contracts awarding model (see next section for a discussion). These factors derive from precise choices of the designer and decision-maker, and are not “cost-overruns” occurred because of inadequate risk management, unexpected facts or external requests, such as environmental standards.

For example, the most radical design change occurred in 1997, when the Parliament requested a total redefinition of line character-istics. Before 1997, the line was conceived as a fast line, separate from the rest of the existing network and accessible to light high-speed rolling stock only, similar to French lines. Afterwards, the nature of the project changed, becoming a mixed high-speed and freight line, equipped with numerous connections (for many km), and capable of also hosting heavy trains. The first fact made the extension much longer than the about 900 km separating Turin from Naples. The second one required a much more demanding infrastructure, with low slopes and with different equipment. In addition, a large part of the line was decided to be built next to highways, in order to prevent further land consumption. However, this required rebuilding all bridges and junc-tions, to overpass both the highway and the rail line. It is this “ex-cessive” design that has almost doubled the cost of the line in real terms, from the 15.5 billion € of 1996 to the 29.6 of 2003.

In fact, all of these must be considered as *deliberate* choices and not as unexpected facts or extra costs due to a longer building phase, which occurred, but accounts for just +11% in real terms between 2003 and 2006. In other words, these are not “cost increases”, but costs due to specific design characteristics, imposed by a political choice in a technical form. In the light of what happened after – but could have been foreseen –these choices represent a waste of money. In particular, no high-speed cargo service exists, many interconnections are not used or used few times a day and the cost of uselessly rebuilding parts of the highways (between Milan and Turin in particular) are accounted as rail costs.

6.2. Overinvestment

The second issue deals with the excessive investment in relation to the existing and future demand. *Overinvestment* can be demonstrated with CBAs, comparing the cost of investment and operation of lines and trains, with the benefits, direct and indirect. A high-speed network

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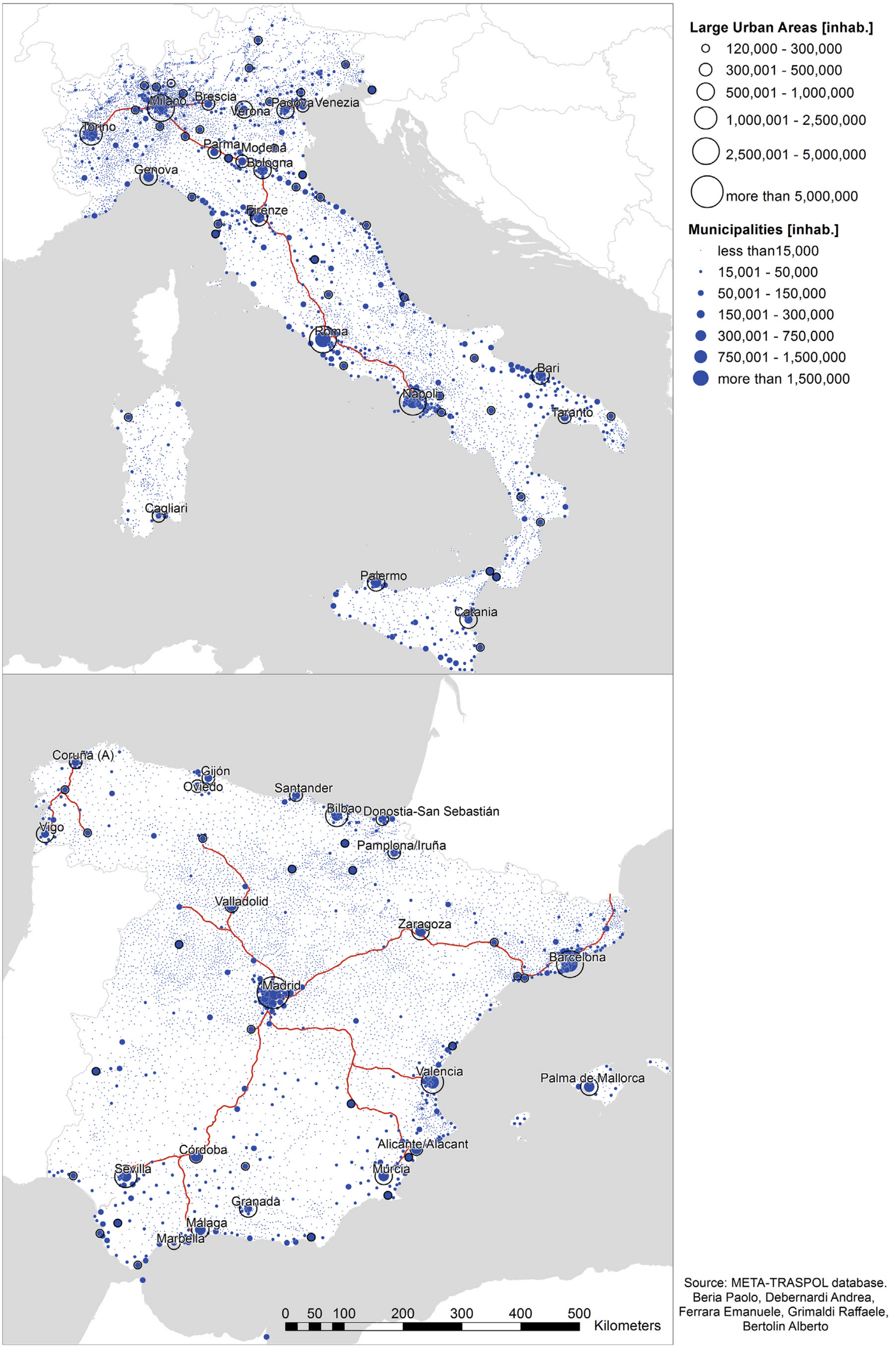
[14] The only ex-ante study presented by the Ministry of Transportation that included the economic impact and a demand forecast was published for the Madrid-Valencia project (See Bel, 2010). The forecast predicted 3.6 million point-to-point passengers, but actual traffic after three years of operation just reached 63% of that number (2.26 million in 2016).



Source: META-TRASPOL database.
Beria Paolo, Debernardi Andrea,
Ferrara Emanuele, Grimaldi Raffaele,
Bertolin Alberto

Fig. 7. High-speed rail infrastructure and population (our elaboration). Data sources: Large Urban Areas 2012 – Eurostat; Municipalities 2011 Spain - Instituto Nacional de Estadística (INE); Municipalities 2011 Italy – Istituto nazionale di statistica (ISTAT).

Table 8
Percentage of investment recovery by type of analysis during the life-cycle of the infrastructure. Source: Betancor and Llobet, 2015.

Corridor	Financial Analysis	Social Analysis
Madrid-Barcelona	45.94%	79,61%
Madrid-Andalusia	11,37%	45,09%
Madrid-Levante	9,60%	42,54%
Madrid-Valladolid	−1,41%	19,03%

could be perfectly working and also performing in an excellent way in terms of quality, but representing an overinvestment if its extension and/or the quantity of train supply exceeds the needs of any reasonable estimation of demand. Together with economy, the geography and the urban structure have an unavoidable influence on demand, and must be considered carefully during the planning process. Ignoring the demand characteristics may drive to disappointing traffic figures once lines are built, typically planning and building a system which is over-dimensioned with respect to its potential demand. This happened quite clearly in Spain, but also on some sections of Italian or French lines (Crozet, 2014b).

As highlighted in previous works (Albalate and Bel, 2011; Albalate et al., 2015a; Marti-Henneberg, 2015), current infrastructure stock in Spain appears disproportionate with respect to any indicator of potential demand. Spain is, by large, a country with a higher ratio km of lines per inhabitants, and the difference is even increasing with respect to the second one – France – because of the lines now under construction. Also, in terms of total volume of passengers and intensity of use (passenger-km per km of network), Spain is far behind any comparable country (Table 7), despite the political intervention to keep prices low.[15]

Italian situation is very different. The sole existing line, less than 1000 km long vs. 2700 km of Spain, serves most of the main cities (see Fig. 7) and consequently the core of potential demand. Moreover, the average distance between main centres is much shorter. For example, Milan and Bologna are separated by 180 km, a distance for which a fast train is extremely competitive, demand density very high, and the competition of air transport is absent. The trains typically stop in 2–3 intermediate cities, helping the load factors and the profitability, of course to the detriment of commercial speed, which in fact is lower than in Spain.

It is worth noticing that the problem of the Spanish network is a pitfall for any HS network, whatever the urban structure, as soon as the lines extend outside the core of demand. The success, real or apparent, of the core lines can be such that more and more cities claim a con-nection with HS with political arguments, resulting in lines that are increasingly marginal. These lines will have the same cost (or higher, like in the case of Italy, where future extensions will be across moun-tainous areas to Genova, Bari and to the South), but less potential passengers and revenues, being more marginal. Even France recently had a rude awakening, with the planned extensions financed with dif-ficulty and at the price of high risks for both private and public sectors (Crozet, 2014a).

As already stated, CBA is the more apt tool to assess whether an investment is worthwhile. A recent CBA (Table 8) has shown that Spanish HS covers variable costs in both financial and social terms in three out of the four corridors (Betancor and Llobet, 2015).[16] But in no case investment cost is covered, which means that, considering current levels of demand and reasonable future projections, these investments will not be profitable either from financial or social perspectives. Noteworthy, even if no wider economic impacts were considered by the authors, Betancor and Llobet (2015) provided results for sensibility and risk analyses that challenged the assumptions of the basic model to show the robustness of their results. Among them, the authors allowed for longer time horizons – much longer in respect to the recommended one of 30 years by the European Commission and the one of 50 years used in their basic analysis – to show that it would be necessary to consider time horizons between 100 and 150 years to obtain positive social profitability of these investments. Due to scarce demand, even considering the typical ranges of wider economic impacts (SACTRA, 2009 suggests adding no more than 10–20% of direct impacts, which in turn depend on patronage), we can affirm that results would remain firmly negative. In Italy, conversely, latest ex-post evaluations[17] are slightly positive (Beria and Grimaldi, 2016) for the entire line, thanks to the dramatic demand increase due to direct competition and because of the network effect on the existing lines (without considering wider economic effects, which are very difficult to estimate while avoiding double counts). It means that, in the case of Italy, the demand is now so high that it justifies even the huge investment cost occurred.

ADIF detailed financial data is not publicly available, nor is RENFE's, even if both of them are government-owned companies. The last audit report conducted by the Tribunal de Cuentas (2015) found that access prices charged by ADIF to RENFE were not high enough to cover ADIF's costs and, consequently, to achieve economic sustain-ability – as explicitly stated by Tribunal de Cuentas. We do not have any new Audit reports available from the Tribunal de Cuentas, although we are aware no relevant increase of access charges has been passed until 2017.

As a final illustration of this overinvestment, it is not unusual to find expensive but underused rail terminals (stations) along the HSR network. Only six stations were used by a million passengers (or close to), while 13 – about one third of the total number of stations – did not reach the 250 daily passengers in 2012.

In conclusion, given the existence of consolidated planning tools and practices, we may infer that, similarly to overdesign, overinvestment is also the outcome of a precise choice. Planners *decided* to provide an extensive network, possibly to all main cities, without caring that it will be barely used at a level capable to cover, in the best case, only the marginal running cost.

6.3. Overquality

The third issue deals with the non-functional aspects of the infrastructure built, which is all the characteristics not related to the intrinsic functionality of the system. This fact is particularly visible, for example, in station buildings, often conceived more as a “monument” and overcoming the pure function of transport infrastructure. Of course, the quality – and moreover the architectural quality – are subjective facts, and it is out of the scope of this paper to discuss the benefits of beautiful buildings. However, it is undeniable that some architecture costs more than equally functional buildings because of design choices. We can find some cases both in Spain and Italy, limiting to the two countries of this paper (Tables 9 and 10). All new Italian stations built

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[15] The ministry of transportation announced, on January 29th, 2013, a new wave of discounts to increase the load factor of the AVE trains. This is contained in the Ministry Press note of that day, available online: https://goo.gl/6uAoj5 (Retrieved on the 22nd of May, 2017).

[16] Betancor and Llobet (2015) considered several social costs and benefits in their social CBA, some of them non-monetary. These components were consistent with the methodology proposed in De Rus (2012). On the one hand, the social cost was composed by (1) infrastructure investment, (2) infrastructure maintenance and operation, (3) investment in trains and (4) maintenance and operational costs of trains. On the other hand, the social benefits considered were (1) time savings, (2) new generated trips, (3) costs avoided (conventional rail, bus, car, airlines), (4) road accidents avoided and (5) road congestion savings. All common and standard in the HSR CBA literature.

[17] Beria and Grimaldi (2016) consider in the analysis: (1) infrastructure investment, (2) infrastructure maintenance and operation, (3) maintenance and operational costs of trains, (4a) time savings due to faster services and (4b) higher frequency, (5) users' benefits for reduced fares, (6) new rail users' benefits, (7) costs avoided (conventional rail), (8) car externalities avoided and (9) additional rail externalities.

Table 9
Cost and characteristics of new Italian stations.

station	cost (station only)	surface (sqm)	tracks		cost €/sqm	Passengers/year
Firenze Belfiore	350 M€	48,700	4	underground	7187	under construction
Torino Porta Susa	79 M€	37,000	6	underground	2135	9 000 000
Napoli Afragola	61 M€	38,000	6	greenfield	1605	opened 2017
Reggio Emilia AV Mediopadana	79 M€	20,000[a]	4	greenfield	3950	600 000

[a] Estimated.

Table 10
Cost and characteristics of new Spanish stations.

station	cost (station only)	surface (sqm)	tracks		cost €/sqm	Passengers/year (2015)[a]
Zaragoza-Delicias	238 M€	44,000	10	Greenfield	5407	2,854,500
Málaga-María Zambrano	134 M€	51,400	11	Greenfield	2607	2,491,600
Camp de Tarragona	28 M€	54,107	8	Greenfield	517	821,800
Girona	31 M€	28,720	4	Greenfield	1080	1,045,100

[a] Including passengers of long distance conventional services.

outside cities and in addition to the existing central station have been designed by famous international architects, and they are characterised by catchy buildings often presented as landmarks. The new Reggio Emilia AV "Mediopadana" is the most relevant case, designed by Santiago Calatrava and costing 79 M€, together with Napoli Afragola by Zaha Hadid, costing 61 M€. Both are built in non-urbanised areas. Also, Turin and Florence underground stations present buildings and spaces characterised by monumentality and cost 79 M€ and 350 M€ respectively (excluding the access tunnels).

In addition, some Spanish stations are conceived as landmark buildings, such as Madrid-Atocha, Zaragoza Delicias, or Málaga-María Zambrano. They are all at the centre of important urban redevelopments, in contrast to Italian cases, but are largely redundant in terms of space available to travellers and, consequently, of cost. An illustration of such excess is the new HSR station in Vigo, designed by Thom Mayne, whose initial project involved more than 120,000 m^2 with an expected cost of 180 million euros, reduced in 2012 to a smaller building of slightly more than 80,000 m^2 with an expected cost of 105 million euros. Despite the dimension and the cost, it hosts a demand of passengers lower than 13,000 per week.

Overquality can go beyond the architectural/aesthetic dimension. Also, the performance of the line can be interpreted in terms of overquality, if the actual impact on users' choices and benefits are limited.

Travel time, in fact, is just one of the elements influencing users' choices (together with frequency, rolling stock, and prices), and maximum line speed is just one of the parameters influencing travel time (together with access time, waiting time, intermediate stops, acceleration, etc.). Consequently, the choice of extending the top-speed of lines is limitedly reducing travel time (already clearly underlined by Bettini et al., 1996) and may have a limited effect on patronage, especially if the elasticity of travel time is low, and on users' benefits.[18]

Elasticity has been estimated both in Spain and Italy, and values found are characteristic of a rigid situation. Roman et al., (2010) estimated the direct elasticity of travel time of the probability of choosing HSR in -0.58 in the Madrid-Zaragoza section and in -0.38 in the Madrid-Barcelona route. Cross-elasticities were also computed in respect to the main alternative modes, finding a cross elasticity of 0.04 in the Madrid-Zaragoza section (in respect to cars) and 0.11 in the Madrid-Barcelona route (in respect to planes). Similar values of cross-elasticity of car choice probabilities with respect to HS time has been found in Italy (Cascetta et al., 2011), with values of 0.035–0.048.

In most cases, top-speed also has a negative influence on construction costs. In particular, the geometry of curves changes; radiuses must be longer, and this could imply more bridges and tunnels, especially in mountainous or highly urbanised areas. In addition, these detours increase the length of the line. It is obviously difficult to estimate which is the extra cost associated with an increase of speed, as usually the two alternatives are not evaluated together and do not allow a comparison, but it is not negligible.

Summarising, the choice of designing faster lines (for example, passing from 250 km/h to 300 km/h) implies higher costs and, in most cases, gives marginal benefits in terms of users and surplus. Given the fact that the trade-off between these benefits and the extra costs associated has never been evaluated in the analysed countries, deciding for the 300 km/h model just because of speed's sake can be seen as a form of overquality.

7. The drivers of *planning optimism*

The previous sections showed that the problems of high-speed megaprojects go beyond the mismatches between forecasted and actual costs and demand. We observed a lack of consideration for the low potential demand (in Spain and, limitedly, in Italy) and design choices which raise construction costs (in Italy and, limitedly, in Spain), sometimes without any functional benefit. This section will discuss the drivers of these patterns, that we define as *planning optimism*.

7.1. The planning process

The first driver of *planning optimism* lays in the rules of the planning process. A number of elements contribute to the planning optimism, allowing (or not blocking) inefficient projects.

a. Both Italy and Spain did not foresee, at the moment of planning, a clear role for CBA to assess infrastructure investment. The absence of public and transparent assessment documents allowed the decision makers to concentrate on emotional or political arguments, such as economic development or national cohesion.
b. Similarly, the lines were planned mostly by looking at the supply-side (Albalate and Bel, 2011; Betancor and Llobet, 2015), lacking the appropriate tools to simulate the potential demand and its behaviour. In other words, these lines were justified in terms of capacity and speed increase, which belong to the engineering side, but did not consider the geography and the economics of demand (as explained in section 6.2).

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[18] To have an idea of the impact in terms of welfare gains, De Rus and Roman (2006) have estimated that the value of the time of HSR users for the Madrid-Barcelona line was estimated at 19.33 euros/hour. This means that saving one minute would be valued at 0.32 cents per average passenger, assuming that this value is true also for marginal gains.

c. Both of the previous elements can be interpreted in terms of *asymmetric information*, where some actors have more information than others and can thus rule the game. In particular, rail agencies (Renfe in Spain, and in Italy, TAV at the beginning and Ferrovie dello Stato later) hold all information about the real demand conditions, in addition to all cost and technical parameters. On the other side, the State and the local administrations do not have the tools and the information to contrast these positions (not necessarily wrong, of course), or even to have a proper one on technical issues. The consequence is that their focus moves on to other arguments, such as the mentioned political and macroeconomic issues, or even ideological or symbolic ones (Minn, 2013; Katz-Rosene, 2016).

7.2. The actors and their goals

In fact, it is unavoidable that a huge effort such as a high-speed national programme involves a number of actors, or stakeholders, making the shape of the decision process complex and crucial in defining the final outcome. As mentioned before, rail agencies played a crucial role, together with the State, local administrations, and industrial groups.

In both the Spanish and Italian cases, the main goal of *rail companies* was to renew their old or saturated lines and possibly re-launch their business, which really suffered during the Nineties. The *States*, aside from the Keynesian argument of fostering the economy (Vickerman and Ulied, 2009), invoked three political reasons for HSR investments: political centralisation, national prestige, and promotion of domestic industry. None of them, at least in those years, was based on a technical approach, but showed a power capable of justifying billions of euros in expenditures without major opposition. In fact, similar arguments were used by *local authorities*, seeing HSR as a boost for their local economies, with the interesting “plus” of being at no cost for their budgets. Also, *construction companies* and *industrial groups* were interested into these megaprojects, and were capable of mobilising huge amounts of money under the label of modernisation. Indirectly, *associations* such as environmental groups played a role in fostering expensive and sometimes unjustified projects, under the flag of environmental protection.

The most interesting thing is that all actors went exactly in the same direction, despite starting from different premises: an expansion of investment programmes, associated with excessive costs and scarce demand, at the expense of taxpayers. We may affirm that all of them transformed a *transport project*, such as a high-speed rail, into a *political project* (Beria, 2008), that is, a projects whose preeminent function deals with the building of political consensus.

Our cases are excellent demonstrations of such convergence on *political goals*. The HSR in Spain does not respond to a transport policy at the service of productivity and welfare, but it is a peculiar case of pure administrative ideology: centralisation (Albalate et al., 2012). The bipartisan focus posed on the connection of provincial capitals with the centre of the peninsula,[19] as a form of “nation building”, clarifies the concept. Using infrastructure policy for nation building in Spain has been a regular pattern in railway policy since the XIX century (Bel, 2011), and in all types of interurban in-frastructure policy since the XVIII century (Bel, 2012). Territorial homo-genization was one of the primary fields where centralized nation building objectives were implemented in Spain, with the objective of “giving a un-ique image of the social body” (Álvarez, 2001: 535). This observation is consistent with Benedict Anderson’s (1983) view of nationalism as a project to establish national cultures built to create the imagined community. This approach also connects with Hobsbawm (1990) vision of nationalism as the creation from above of the institutional and social structure, creation by which the infrastructure policy would have been an instrument.[20] In this regard, demand is not a key factor in investment decisions, but provides a similar level of supply of infrastructure (quantity as well as technology) to all radial routes from the political capital, whether they are intensively used or not.[21] Indeed, this has been empirically tested for the Spanish case in Albalate et al. (2012). Furthermore, and beyond a purely ideological ra-tionale, this is also consistent with more pragmatic factors, such as those theoretically posed by Faguet (2008), who emphasizes that when residual bargaining powers are located in the capital city, her residents directly benefit from centralizing policies.

The use of rail connections as a tool for centralisation has not been a driver – or just very weak – in Italy in the Nineties. The line Milan – Venice, similarly important, has been postponed not for political reasons, but because saturation on the North – South rail line was more severe (Erba and Ponti, 2006). Similar political arguments in Italy are rising more recently. The remoteness of Southern Regions with respect to the North, generating an “infrastructural gap” jeopardizing Southern economy, is the *leit-motif* of newer projects. The forthcoming extensions towards Bari, Reggio Calabria and Sicily are clearly presented as economy-fostering actions, even if the demand on these corridors is, and will likely remain, much scarcer than in the main sections (Beria and Grimaldi, 2011). Similar equity or economic development argu-ments are presented in Spain to justify investments in poorer regions, even if the empirical evidence indicates that HSR projects do benefit the larger and more dynamic economic nodes rather than the less devel-oped and smaller nodes (Haynes, 1997; Van den Berg and Pol, 1998; Givoni, 2006; Preston and Wall, 2008; Vickerman, 2015).

Secondly, HSR policy has been, especially in Spain, a tool for achieving ‘national prestige’ (OECD/ITF, 2014; Beria, 2008), given the label of modern transportation technology involved in HSR. This has been oriented on one side, to gain political support for the successive governments, and on the other, to provide reputation and to allocate budgetary funds to the largest Spanish construction firms. Again, in Italy, national prestige, per se, has not been a dominant argument, but is used in some cases.

The third rationale stated above involves a further actor in the game: national industry and its promotion. As explained in Bel et al. (2014), five Spanish construction companies ranked among the largest 50 construction firms worldwide, and four of them have been very active in obtaining contracts to build HSR lines: ACS, FCC, Sacyr, and Ferrovial. All of these four companies have also developed a close relationship with the main Spanish political parties, by means of donation of funds, and by appointing politicians (formerly in top governmental positions) to the company board (Castells and Trillas, 2013). Also, in Italy, all construction works have been carried out by national companies, moreover using a “general contractor” scheme awarded by the initial concessionaire (TAV SpA) without any competitive tender and before final design (“*progetto esecutivo*”) was available (ANAC, 2015). This gave, to the General Contractors, an extreme freedom of movement, also because physical construction was done by third-party companies directly chosen without any control over the expenditure. This fact

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[19] Objective officially stated for the first time by the former prime minister José María Aznar on 25 April 2000 (Diario de Sesiones del Congreso, April 25, 2000, p. 29).

[20] In this way, it is easier to understand explanations of the policy of the extension of high-speed rail in Spain, such as that of the former Socialist Minister of Public Works Magdalena Álvarez: "We are sewing Spain with steel cables. This is the true way of making a country, of defending the unit of Spain: sewing it with steel threads.” (Interview published in various newspapers of the media group Vocento on May 11, 2008). Or the most recent statement by the Conservative Minister of Public Works Ana Pastor: "HSR makes Spaniards equal" (*TVE Informe Semanal*, April 21, 2012). It is not at all common to find justifications of this kind in the infrastructure policies of other EU countries.

[21] At this point, one could argue that these past decisions created path dependence. That could explain that this model would continue to be applied in the future, without necessarily persisting in the national construction objective, but rather as a natural continuation of an assignative dynamic following an initial accident, such as the road policy of the 18th century, or the 19th century railroads policy (as suggested by Myro et al., 2014). However, the path-dependence hypothesis would require that there has been a natural evolution, a market evolution, without further exogenous interventions necessary for the evolutionary dynamics of the economy (David, 2007). Clearly, this is not the case of the radial Spanish infrastructure policy, which has persistently needed per-sistently the government's financial and regulatory support, as shown in Bel (2011, 2012).

has been recognised by the CEO of Ferrovie dello Stato as one of the main causes of extra costs (Corte dei Conti, 2009: 19): 14–20% more, quantified in 4–6 million Euros per km of line.

This convergence of politics and business has been justified, not only in Italy and Spain (Crozet, 2014a), as an *industrial policy* intended to promote national champions, which provides an incentive to emphasise the supply side in the extension of the infrastructure. More prosaically, also, private interests and corruption could have played a key role.[22] An effective interpretation of this collusion can be given in terms of principal-agent model (Arrow, 1968; Laffont and Martimort, 2009). The literature mostly refers to principal-agent problems in terms of local administrations capable of driving central state investment decisions thanks to their informative advantage, especially in terms of demand and alternative solutions (Chen, 2007; Lowe, 2013; Helland and Sørensen, 2009), or in the field of PPPs (Iossa and Martimort, 2009; Zhou et al., 2014).

Given the limited role of local administrations in high-speed planning in both countries, the lack of incentives (where not perverse incentives) towards cost containment is mostly towards the construction companies. Worryingly, this is also spreading to planning choices. For example, in Italian HS, not only technical choices, but also planning choices such as the position of interconnections or the impact mitigation of infrastructures, were totally left to a *general contractor* and not controlled at all by the principal-Ministry. A similar problem is the dichotomy between the Transport Ministry, who plans and manages transport choices, and the Treasury, who pays for others' choices. Again, the lack of information of the latter about the goals of the first is the grounds for many of the problems mentioned in the paper.

8. Conclusions

The paper has analysed ex-post the main characteristics of two of the largest European high-speed programmes: the Spanish and the Italian ones. With respect to the usual (according to the literature) pitfalls of megaproject planning, the two cases present some interesting elements of difference: demand is not below expectations, and costs are not above forecasts. Therefore, both projects may appear extremely successful, for example, because they were able to push a significant modal shift from plane and car to train and because they significantly raised the quality of the rail systems of both countries.

However, the in-depth analysis of traffic figures, decision history of the projects, geography of the countries, and economic and financial results, tell a story of *delusion*.

i. Even when insignificant cost overruns occur, costs can be a sign of failure. The Italian HS project became overwhelmingly expensive, basically due to redundant design choices and to the use of a general contractor not following the rules of transparency and efficiency when assigning the construction works. In other words, costs were not underestimated: they were just deliberately inflated by promoters to produce an *overdesigned* project. Similarly, a certain monumentality of most of the European HS projects (for example, in stations) can be seen as a form of *overquality*, which ultimately raises costs above the level necessary to guarantee a full functionality of the system.
ii. The Spanish network – and many of its stations – is clearly out of scale with respect to the potential and actual demand, much more than any other European country. It is a case of deliberate *over-investment*, i.e. an investment excessively large with respect to any realistic expectation because demand forecasts were never relevant to justify any HSR project. The cogent causes of low demand are geography and the presence of intermodal competition, which, in Spain, is characterised by medium-sized cities separated by hundreds of km from Madrid (Martin Cañizares et al., 2014). This configuration does not allow economies of density in the network and is intrinsically determining limited demand density, long trips, high maintenance costs and direct competition with air transport, typically cheaper for longer distances (Albalate et al., 2015b).
iii. Among the drivers of planning and design choices, political arguments ground many of the characteristics of the system and can explain the deluding economic success of the HS trains. This is particularly true in Spain, where the high-speed has been used as a mean of centralisation around the political capital following a unique and exclusively radial design, as much in the development stage as in the planned, final goal (Albalate et al., 2012). AVE aims to be the backbone of a politically centralized State with urban systems of satellite cities around a large hub, as is the French case with Paris (See Albalate and Bel, 2012b).

Although we pay attention to the planning bias that led to the economic failure of this huge investment effort, we must also note that there are other factors that exerted influence on the outcomes. For instance, recent changes in the airline market, with the emergence of low-cost carriers, have hampered the growth potential of HSR demand in most of Europe, especially out of the main corridors or city-pairs. Indeed, alternative modes were also boosted and played against the potential demand attraction of HSR: the expansion of airports and high-capacity road construction "in competition" with HSR deployment. This made Spain a country where infrastructure oversupply is the rule in all modes of transportation (Albalate et al., 2015b). This lack of integrated transportation policy was against the exploitation of economies of scale and against potential complementarities and synergies that could arise from an integrated and rational transportation planning. In Italy, the lack of integrated transport policies did not jeopardise HS demand, at least in the main North-South corridor. Rather, a certain oversupply of rail capacity has become an advantage and has allowed the rise of a fierce competition, which pushed quality, frequency and lowered prices in favour of travellers.

The main remedies to these evidences are the use of a rigorous economic evaluation, transparency in the hidden agendas behind public works, a sound planning process, impermeable to the pet-projects of politicians as much as possible and adherent to real transport needs as much as possible.

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[22] In the case of Italy, this will be clarified by the inquiry "Sistema", presented on March 16th, 2015 and whose trial is still ongoing.

Appendix

Table 11
Italian high-speed network operating sections (2017).

Section	Opening year(s)	Maximum speed [km/h]	Line length [km]
Turin – Salerno axis			**749**
Turin – Milan	2006–2009	300	125
Milan – Bologna	2008	300	182
Bologna – Florence	2009	300	79
Florence – Rome	1977–1992	250	254
Rome – Naples	2005–2009	300	205
Naples – Salerno	2009	250	29
Milan – Venice axis			**92**
Milan – Treviglio	2007	200	27
Treviglio – Brescia	2016	300	40
Padua – Venice	2006	220	25
Other lines			**114**
Verona – Bologna	2009	200	114

Table 12
Spanish high-speed network operating sections.

Section	Opening year	Maximum Speed [km/h]	Length (Km)
Madrid-Andalucía			**648**
Madrid-Seville	1992	300	472
La Sagra-Toledo	2005	270	21
Córdoba-Málaga	2007	300	155
Madrid-Northwest			**346**
Madrid-Valladolid	2007	300	180
Valladolid-León	2015	200	166
Madrid-French Border			**831**
Madrid-Lleida	2003[a]	300	442
Zaragoza-Huesca	2003	200	79
Lleida-Barcelona	2008	300	179
Barcelona-Figueres	2010[bc]	300	131
Madrid-Levante			**637**
Madrid-Albacete	2010	300	322
Bifurcation Albacete-Valencia	2010	300	150
Albacete-Alicante	2013	300	165
Madrid-Galicia			**250**
Santiago-Ourense	2011	300	88
A Coruña-Santiago	2011	200	62
Olmedo-Zamora	2015	200	100
Total			**2712**

[a] Note that high-speed infrastructure arrived in Lleida in 2003, but AVE services at 250 km/h did not start until 2006. Prior services were travelling at maximums speeds of 200 km/h.

[b] Distance from Barcelona to the municipality of Figueres, where the concession of TP Ferro on the Le Perthus Tunnel and the infrastructure links between Figueres and Perpignan (France) starts. The link in the Spanish territory covers 19 km, from a total of 44 km.

[c] As in the previous case, direct services with high-speed rail services (> 250 km/h) connecting Barcelona to Figueras did not start until 2013.

References

Albalate, D., Bel, G., 2011. Cuando la economía no importa: auge y esplendor de la Alta Velocidad en España. Rev. Econ. Apl. 19 (55), 171–190.

Albalate, D., Bel, G., 2012. High Speed Rail: lessons for policy makers from experiences abroad. Publ. Adm. Rev. 72 (3), 336–349.

Albalate, D., Bel, G., 2012b. The Economics and Politics of High Speed Rail: Lessons from Experiences Abroad. Rowman and Littlefield (Lexington Books), Lanham (Maryland, US).

Albalate, D., Bel, G., 2015. La experiencia internacional en alta velocidad ferroviaria, FEDEA WP 2015-02. FEDEA, Madrid (Spain).

Albalate, D., Bel, G., Fageda, X., 2012. Beyond the efficiency-equity dilemma: centralization as a determinant of government investment in infrastructure. Pap. Reg. Sci. 91 (3), 599–615.

Albalate, D., Bel, G., Fageda, X., 2015a. When supply travels far beyond demand: causes of oversupply in Spain's transport infrastructure. Transport Pol. 41, 80–89.

Albalate, D., Bel, G., Fageda, X., 2015b. Competition and cooperation between high-speed rail and air transportation services in Europe. J. Transport Geogr. 42, 166–174.

Álvarez, J., 2001. Mater Dolorosa. La idea de España en el siglo XIX. Taurus, Madrid (Spain).

ANAC, 2015. Delibera numero 6 del 08 aprile 2015. Fasc. 3137/2013-Sistema Ferroviario Alta Velocità/Alta Capacità. Monitoraggio dei contratti in corso di esecuzione. Roma, Italy.

Anderson, B., 1983. Imagined Communities. Reflections on the Origin and Spread of Nationalism. Verso, London (UK).

Arrow, K.J., 1968. The economics of moral hazard: further comment. Am. Econ. Rev. 58, 537–539.

Bel, G., 2010. La racionalización de las infraestructuras de transporte en España. Cuadernos Económicos de ICE 80, 211–228.

Bel, G., 2011. Infrastructure and nation building: the regulation and financing of network transportation infrastructures in Spain (1720–2010). Bus. Hist. 53 (5), 688–705.

Bel, G., 2012. Infrastructure and the Political Economy of Nation Building in Spain, 1720–2010. Sussex Academic Press, Eastbourne (UK).

Bel, G., Estache, A., Forcaud, R., 2014. Transport infrastructure failures in Spain: mismanagement and incompetence, or political capture? In: Søreide, T., Williams, A. (Eds.), Corruption, Grabbing and Development. Real World Challenges. Edward Elgar, Cheltenham (UK).

Bergantino, A.S., 2015. Incumbents and new entrants. In: Finger, M., Messulam, P. (Eds.), Rail Economics, Policy and Regulation in Europe. Edward Elgar Publishing, Cheltenham (UK).

Bergantino, A.S., Capozza, C., Capurso, M., 2015. The impact of open access on intra-and inter-modal rail competition. A national level analysis in Italy. Transport Pol. 39, 77–86.

Beria, P., 2008. The Megaprojects' Issue. Evaluation, Policies and Decision Making of Large Transport Infrastructures. Ph.D. Dissertation. Politecnico University of Milan, School of Doctoral Programmes, Milano (Italy).

Beria, P., Grimaldi, R., 2011. An early evaluation of Italian high-speed rail projects. Tema - J. Land Use, Mobil. Environ. 4 (3), 15–28.

Beria, P., Grimaldi, R., 2016. An ex-post cost benefit analysis of Italian high speed train, five years after, 2016. In: Working papers SIET 2016 – ISSN 1973-3208. XVIII SIET Conference, Genoa (Italy), July 4th-5th, 2016.

Beria, P., Grimaldi, R., 2017. Reality and opportunities for on-track competition in HSR. In: Albalate, D., Bel, G. (Eds.), Evaluating High-speed Rail. Interdisciplinary Perspectives. Routledge, Abingdon (UK).

Beria, P., Ponti, M., 2009. Regulation of investments on transport infrastructures in Italy. In: 2nd Annual Conference of Competition and Regulation in Network Industries, Brussels, Belgium, November 20, 2009, Available at: http://www.jcrni.org/extranet/index.php.

Beria, P., Redondi, R., Malighetti, P., 2016. J. Rail Transport Plann. Manag. 6 (3), 271–283.

Betancor, O., Llobet, G., 2015. La contabilidad financiera y social de la alta velocidad en España, Estudios sobre la economía española FEDEA – 2015/08. FEDEA, Madrid (Spain).

Bettini, V., et al., 1996. Valutazione del progetto Alta Velocità in Italia. Retrieved from (5/1/2018). http://digilander.libero.it/altavoracita/storico/altavel/altavel.htm.

Campos, J., De Rus, G., 2009. Some stylized facts about high-speed rail: a review of HSR experiences around the world. Transport Pol. 16 (1), 19–28.

Cantarelli, C., 2009. Cost Overruns in Dutch Transportation Infrastructure Projects, Bijdrage Aan Het Colloquium Vervoersplanologisch Speurwerk, Antwerpen (Belgium), 19 and 20 November 2009.

Cascetta, E., Papola, A., Pagliara, F., Marzano, V., 2011. Analysis of mobility impacts of the high speed Rome–Naples rail link using withinday dynamic mode service choice models. J. Transport Geogr. 19 (4), 635–643.

Castells, P., Trillas, F., 2013. The effects of surprise political events on quoted firms: the March 2004 election in Spain'. Series Journal of the Spanish Economic Association 4 (1), 83–112.

Chen, W., 2007. Analysis of rail transit projection selection bias with an incentive approach. Plann. Theor. 6 (1), 69–94.

Cohen, M.D., March, J.G., Olsen, J.P., 1972. A garbage can model of organizational choice. Adm. Sci. Q. 17 (1), 1–25.

Corte dei Conti, 2009. Relazione sul risultato del controllo eseguito sulla gestione finanziaria di Rete Ferroviaria Italiana (R.F.I.) S.p.A. per l'esercizio 2007 [in Italian]. Delibera 44–09, Roma (Italy).

Crozet, Y., 2014a. Extension of the high speed rail network in France: facing the curse that affects PPPs in the rail sector. Res. Transport. Econ. 48, 401–409.

Crozet, Y., 2014b. Performance in France. From appraisal methodologies to ex-post evaluation. In: OECD and ITF (2014), the Economics of Investment in High-speed Rail, ITF Round Tables, No. 155. OECD Publishing, Paris (France).

David, P., 2007. Path dependence: a foundational concept for historical social science. Cliometrica 1 (2), 91–114.

Dell'Alba, R., Velardi, V., 2015. Forecast of passengers demand on HS rail services: a system of models. Railw. Eng. [Ingegneria Ferroviaria] 70 (3), 215–263.

Dente, B., 2014. Understanding Policy Decisions. Springer International Publishing.

De Rus, G., 2012. Economic Evaluation of the High Speed Rail, Expert Group on Environmental Studies. Ministry of Finance, Stockholm (Sweden).

De Rus, G., Inglada, V., 1993. Análisis coste-beneficio del tren de alta velocidad en España. Rev. Econ. Apl. 1 (3), 27–48.

De Rus, G., Roman, C., 2006. Análisis económico de la línea de alta velocidad Madrid-Barcelona. Rev. Econ. Española 42 (14), 35–79.

Erba, S., Ponti, M.G., 2006. Il sistema dei trasporti. In: Barucci, P., Becheri, E. (Eds.), L'industria turistica del Mezzogiorno, Il Mulino, Bologna (Italy).

Eurostat, 2015. Cities (Urban Audit) Database: Population on 1 January by Age Groups and Sex - Larger Urban Zone [urb_lpop1]. Last update: 09-06-2015.

Faguet, J.P., 2008. Why so Much Centralization? A Model of Primitive Centripetal Accumulation, LSE STICERD Research Paper No. DEDPS43. London School of Economics, London (UK).

Flyvbjerg, B., 2007a. Cost overrun and demand shortfalls in urban rail and other infrastructure. Transport. Plann. Technol. 30 (1), 9–30.

Flyvbjerg, B., 2007b. Policy and planning for large-infrastructure projects: problems, causes, cures. Environ. Plann. Plann. Des. 34 (4), 578–597.

Flyvbjerg, B., Bruzelius, N., Rothengatther, W., 2003. Megaprojects and Risk. An Anatomy of Ambition. Cambridge U.P., Cambridge (UK).

Flyvbjerg, B., Holm, M.S., Buhl, S., 2002. Underestimating costs in public works projects error or lie? J. Am. Plann. Assoc. 68 (3), 279–295.

Flyvbjerg, B., Garbuio, M., Lovallo, D., 2009. Delusion and deception in large infrastructure projects: two models for explaining and preventing executive disaster. Calif. Manag. Rev. 51 (2), 170–193.

Flyvbjerg, B., Skamris Holm, M.K., Buhl, S.L., 2006. Inaccuracy in traffic forecasts. Transport Rev. 26 (1), 1–24.

Givoni, M., 2006. The development and impact of the modern high speed train. Transport Rev. 26 (5), 593–612.

Haynes, K.E., 1997. Labor markets and regional transportation improvements: the case of high speed trains. Ann. Reg. Sci. 31 (1), 57–76.

Helland, L., Sørensen, R.J., 2009. Geographical redistribution with disproportional representation: a politico-economic model of Norwegian road projects. Publ. Choice 139 (1), 5–19.

Hobsbawm, E.J., 1990. Nations and Nationalism since 1780: Programme, Myth, Reality. Cambridge University Press, Cambridge (UK).

Iossa, E., Martimort, D., 2009. The Theory of Incentives Applied to the Transport Sector.

Katz-Rosene, R., 2016. To build or not to build? Competing narratives of high-speed rail development in Canada. Mobilities 12 (5), 1–20.

Laffont, J.J., Martimort, D., 2009. The Theory of Incentives: the Principal-agent Model. Princeton university press.

Locatelli, G., Invernizzi, D.C., Brookes, N.J., 2017. Project characteristics and performance in Europe: an empirical analysis for large transport infrastructure projects. Transport. Res. Pol. Pract. 98, 108–122.

Love, P.E., Smith, J., Simpson, I., Regan, M., Olatunji, O., 2015. Understanding the landscape of overruns in transport infrastructure projects. Environ. Plann. Plann. Des. 42 (3), 490–509.

Lowe, K., 2013. Funding rail: federal decisions and local financing. Publ. Works Manag. Pol. 18 (2), 127–144.

Makovšek, D., 2014. Systematic construction risk, cost estimation mechanism and unit price movements. Transport Pol. 35, 135–145.

Marti-Henneberg, J., 2015. Attracting travellers to the high-speed train: a methodology for comparing potential demand between stations. J. Transport Geogr. 42, 145–156.

Martin Cañizares, M.P., López Pita, A., García Álvarez, A., 2014. Structure and topology of high-speed rail networks. Proc. Inst. Civ. Eng. Transport 168 (5), 415–424.

MEF, 2016. Documento di Economia e Finanza 2016. Allegato: Strategie per le infrastrutture di trasporto e logistica, Ministero dell'. Economia e delle Finanze, Roma (Italy).

MEF, 2017. Documento di Economia e Finanza 2017. Allegato: Connettere l'Italia: fabbisogni e progetti di infrastrutture, Ministero dell'. Economia e delle Finanze, Roma (Italy).

Merewitz, L., 1973. Cost overruns in public works. In: Niskanen, W., Hansen, A.C., Havemann, R.H., Turkey, R., Zeckhauser, R. (Eds.), Benefit Cost and Policy Analysis. Aldine, Chicago (Illinois, US).

Minn, M., 2013. The political economy of high speed rail in the United States. Mobilities 8 (2), 185–200.

Myro, R., Martí, P., Rey, B., 2014. Diseño de la red española de transportes: ¿decisiones ideológicas o trayectorias dependientes? In: Paper Presented at the XL International Conference on Regional Science, 20 and 21 November 2014, Zaragoza (Spain).

Næss, P., Flybvjerg, B., Buhl, S., 2006. Do road planners produce more 'honest numbers' than rail Planners? An analysis of accuracy in road-traffic forecasts in cities versus peripheral regions. Transport Rev. 26 (5), 537–555.

Nash, C., 2015. When to invest in high speed rail. J. Rail Transport Plann. Manag. 5 (1), 12–22.

Nicolaisen, M.S., Driscoll, P.A., 2014. Ex-post evaluations of demand forecast accuracy: a literature review. Transport Rev. 34 (4), 540–557.

OECD/ITF, 2014. The Economics of Investment in High-speed Rail, ITF Round Tables, No. 155. OECD, Paris (France).

Perl, A.D., Goetz, A.R., 2015. Corridors, hybrids and networks: three global development strategies for high speed rail. J. Transport Geogr. 42, 134–144.

Preston, J., 2013. The Economics of Investment in High-speed Rail: Summary and Conclusions. International Transport Forum Discussion Papers, No. 2013/30. OECD Publishing, Paris (France).

Preston, J., Wall, G., 2008. The ex-ante and ex-post economic and social impact of the introduction of High-speed trains in South East England. Plann. Pract. Res. 23 (3), 403–422.

RFI, 2007. Rete AV/AC. Analisi dei costi [in Italian], presentation, Rete Ferroviaria Italiana. Ferrovie dello Stato, Roma (Italy).

Roman, C., Espino, R., Martín, J.C., 2010. Analyzing competition between the high speed train and alternative modes. The case of the madrid-zaragoza-barcelona corridor. J. Choice Model. 3 (1), 84–108.

SACTRA, 2009. Transport and the Economy. Stationary Office, London.

Tribunal de Cuentas, 2013. Informe de Fiscalización de las principales contrataciones relacionadas con la construcción de la línea férrea de alta velocidad Madrid-Barcelona, desarrolladas desde el 1 de enero de 2002 hasta la puesta en funcionamiento de la línea (in Spanish). Num. 983, 25 April 2013, Madrud (Spain).

Tribunal de Cuentas, 2015. Informe de fiscalización de la financiación de las infraestructuras ferroviarias en el periodo 2011-2013. Num. 1090, 30 April 2015, Madrid (Spain).

Van den Berg, L., Pol, P.M.J., 1998. The urban implications of the developing European high-speed-train network. Environ. Plann. C Govern. Pol. 16 (4), 483–497.

Van Wee, B., 2007. Large infrastructure projects: a review of the quality of demand forecasts and cost estimations. Environ. Plann. Plann. Des. 34 (4), 611–625. Vickerman, R., 1997. High-Speed rail in Europe: experience and issues for future development. Ann. Reg. Sci. 31 (1), 21–38.

Vickerman, R., 2015. High-speed rail and regional development: the case of intermediate stations. J. Transport Geogr. 42, 157–165.

Vickerman, R., Ulied, A., 2009. Indirect and wider economic impacts of high speed rail. In: De Rus, G. (Ed.), Economic Analysis of High Speed Rail in Europe. Fundación BBVA, Madrid (Spain).

Wachs, M., 1990. Ethics and advocacy in forecasting for public policy. Bus. Prof. Ethics J. 9 (1–2), 141–157.

Zhou, S., Zhang, Y., Zhang, Q., 2014. The way to improve the revenue of high-speed rail corporation in China under commissioned transport model', Service Systems and Service Management (ICSSSM). In: 2014 11th International Conference on (pp. 1–5). IEEE.