



The demand in a railway corridor after the HSR

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Abstract

This paper analyses the changes in mobility and modal share in a railway corridor after the construction of a new high-speed line (HSL), during the last economic crisis.

The following chapters describe the new HSL Madrid-Levante, that connects Madrid with Valencia and Alicante, detailing the fieldwork carried out (before and after the HSL), and finally presents the most relevant results, mainly in relation to modal share.

The first results of the analysis carried out in Madrid-Galicia and Madrid-León / Asturias corridors are also presented.

From the results of these studies, we observe the great modal shift experienced in the relationships where a high-speed rail (HSR) is implemented, turning the railroad into a very important mode of transport, reaching between 25 and 35% of passengers. Airplane experiences a great fall in its demand, maintaining basically the connection traffic, whereas car, although it descends, continues being the dominant mode of transport.

Keywords: High-speed rail (HSR), high-speed line (HSL), demand, modal share, economic crisis.

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1. Introduction

In December 2010, the Madrid-Albacete / Valencia HSL was put into service, allowing a significant improvement in travel time between Madrid, Albacete, Valencia and Alicante, with the introduction of rail services with gauge change (Alvia services).

Subsequently, in June 2013 the HSL between Albacete and Alicante was completed, thus allowing the direct connection in HSR between Madrid and Alicante, also building a new station in Villena.

The following figure shows the Madrid-Levante High Speed Line, currently in service.

The improvement of travel times in rail has been very relevant, as we can be seen in the following figure:

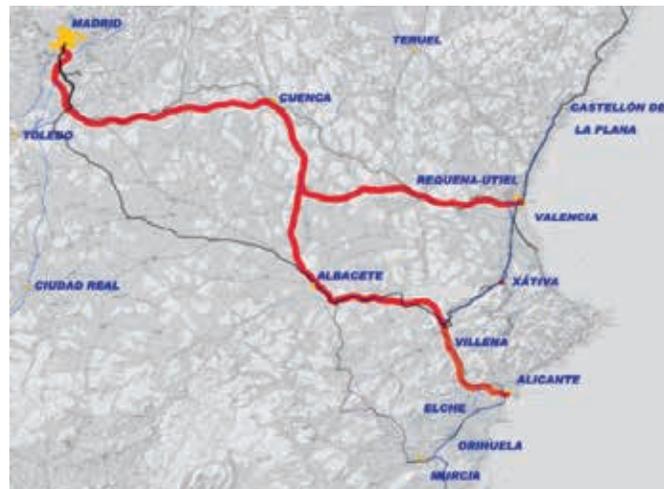


Figure 1. Madrid-Levante HSL.

In 2015 ADIF put into service two new sections of the HSL Madrid-Asturias (Valladolid-León) and Madrid-Galicia (Olmedo-Medina del Campo-Zamora), extending the Madrid-Valladolid HSL opened at the end of 2007.

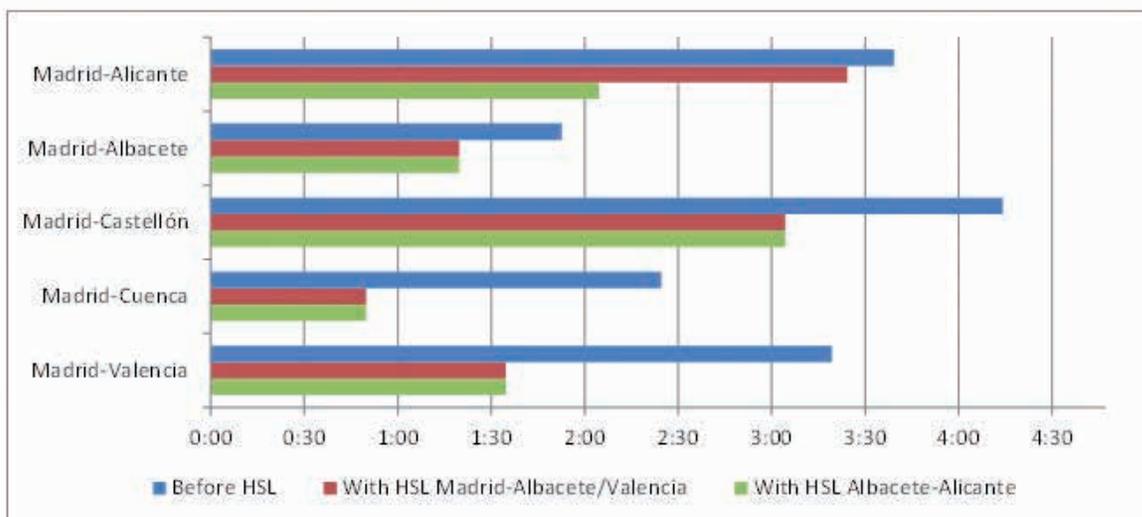


Figure 2. Rail travel times before and after HSR.

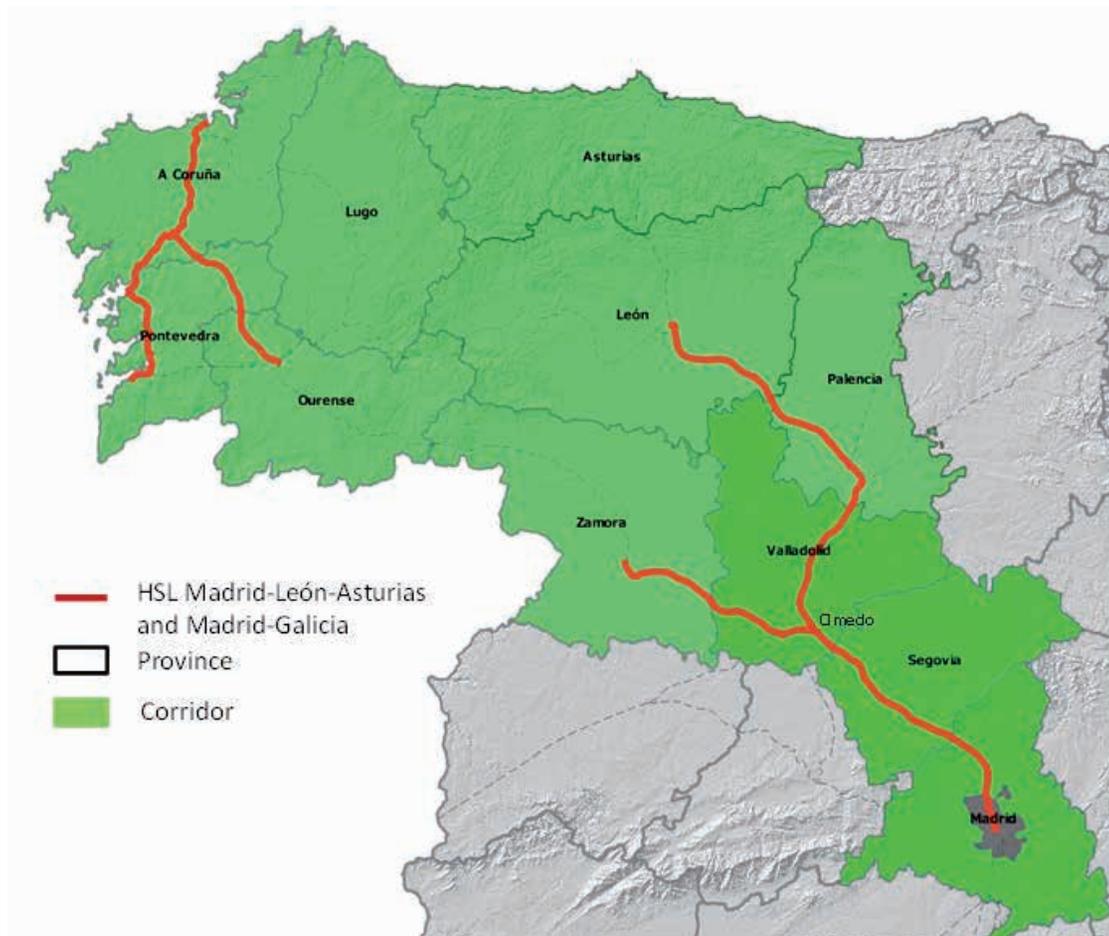


Figure 3. Madrid-Valladolid-León-Asturias HSL and Madrid-Zamora-Galicia HSL.

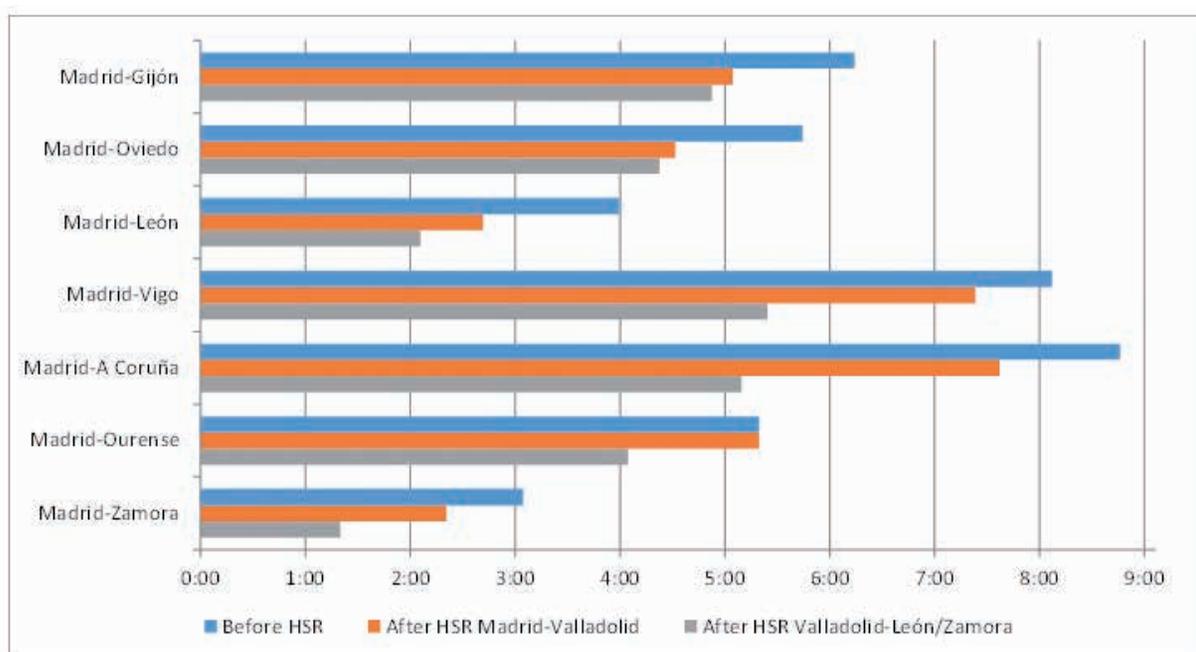


Figure 4. Rail travel times before and after HSR.



2. Effect on transport demand - airplane and rail

The new HSL Madrid-Valencia meant a large increase in the demand for rail passengers (+142%), between the cities of Madrid and Valencia connected in just 1 hour and 35 minutes, and a drastic fall of airplane demand during the first full year of operation (2011). However, the number of passengers of rail and airplane went down by 13%, recovering from 2013 as it's shown in the following figure.

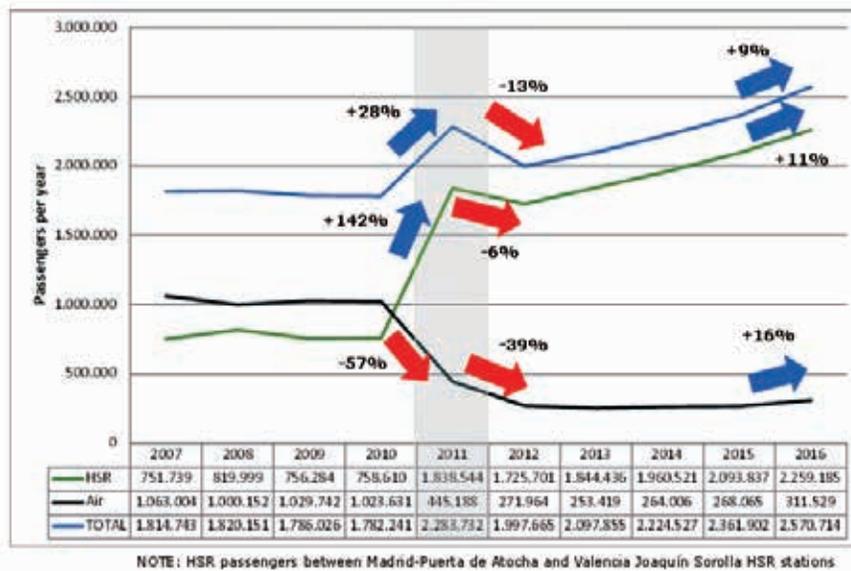


Figure 5. Evolution of rail and air traffic between Madrid and Valencia. Source: ADIF AV.

In the case of Alicante, the evolution was different, initially, in 2011, rail demand barely increased although the Madrid-Albacete section was put into service, however the completion of the line (2013) increased rail demand significantly.

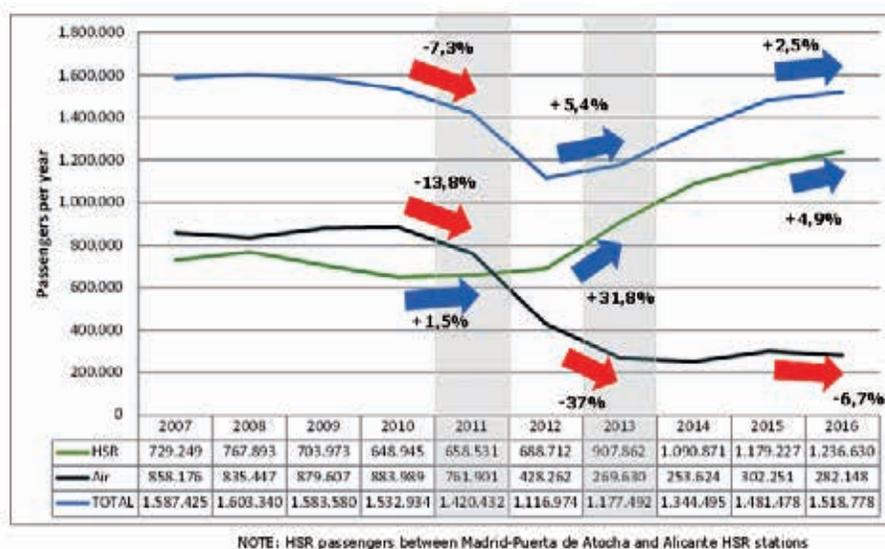


Figure 6. Evolution of rail and air traffic between Madrid and Alicante. Source: ADIF AV.

3. Forecast and current demand - field work

In 2007, a detailed fieldwork was carried out throughout the Madrid-Levante corridor, consisting of surveys and counts in the different modes of transport, as well as the collection of statistical data to establish the main flows in the corridor.



Figure 7. Surveys in corridor Madrid-Levante (2007).

Once the first phase of the line (Madrid-Albacete/Valencia) was put into service, ADIF decided to carry out several fieldwork campaigns to know the changes in the mobility between Madrid and Valencia, with the same methodology as in the previous studies in 2007. Later, in 2013 and 2014, the campaigns focused in the relationship Madrid-Alicante, with surveys and counts before and after the new HSL Albacete-Alicante.

The following table shows the date of these fieldworks.

Relation	Campaigns	
	Winter	Summer
Madrid-Valencia	November 2011	July 2012
	November 2013	July 2014
Madrid-Alicante	April 2013	
	November 2013	July 2014

Table 1. Campaigns of field work carried out between Madrid, Valencia and Alicante

The same type of fieldwork was carried out by ADIF for the corridor Madrid-Galicia/Asturias, in 2008 a complete campaign of surveys was made to establish the real mobility in that moment, and recently (last year) this work was done over with the new sections of HSL Madrid-Galicia and Madrid/Asturias.



4. The evolution of global demand: the effect of economic crisis

In order to analyze the evolution of global demand in these corridors, and also to take into account the period of economic crisis, the observed demands of the following studies have been used:

- 1997: Informative study of the HSL Madrid-Castilla La Mancha-Comunidad Valenciana-Region of Murcia, carried out by Ministerio de Fomento in 1999.
- 2006: Demand study of Madrid-Levante HSL, carried out by ADIF in 2007-2008.
- 2007: Demand study of Madrid-Galicia/Asturias HSL, carried out by ADIF in 2008-2010.
- 2011/2013/2014: Demand study after opening the HSL Madrid-Levante, made by ADIF / ADIF AV in the period 2011-2015.

In the following graphic, we can see the GDP evolution hypothesis considered in ADIF demand studies in the period 2006-2008 and the real GDP variation. Foreseeing an economic downturn in 2008/2009, that is to say, if it were considered that there was an economic crisis, the real evolution of GDP has been very different, with a worsening of the crisis in 2009 much stronger than expected, 1% against the real of -3.6%, and a second period of decline in 2012-2013, totally unforeseen.

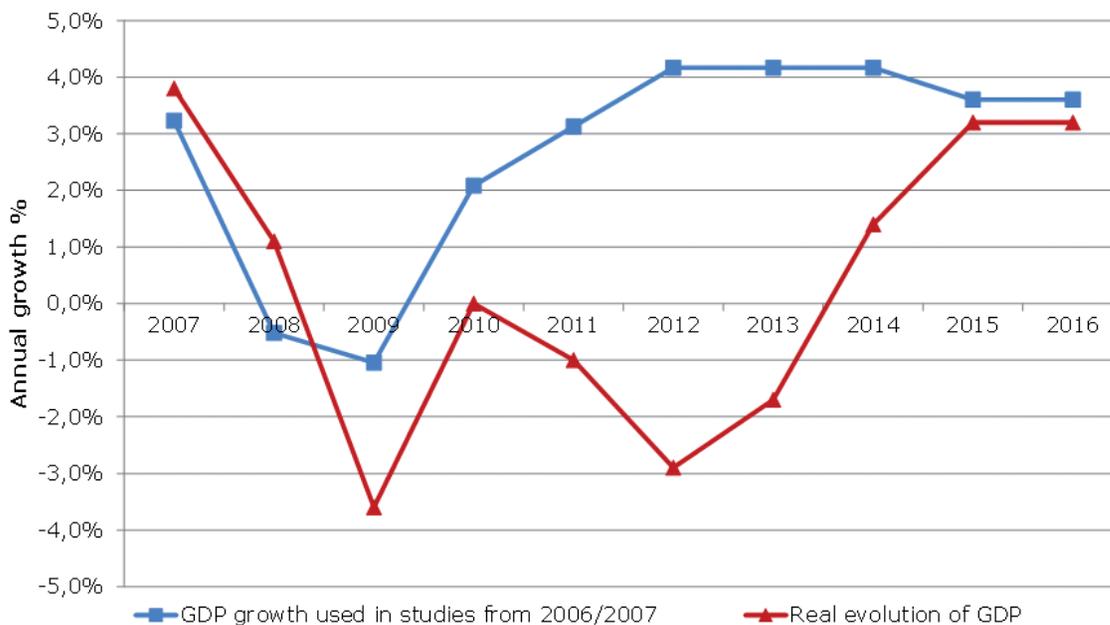


Figure 8. Evolution of GDP.

4.1 Madrid-Valencia

Comparing the evolution of the real demand in this relation in the years 1997, 2006, 2011 and 2013, it is observed that the demand in 2011 was in 2000 levels, that is to say, what is known in Economy as "lost decade". In the data obtained from 2013, there is already a recovery in demand, with an annual rate that is half of the pre-crisis period (2.1% versus 5.5%). The total mobility data is presented without considering the bus, due to the fact that in the various fieldworks it was not possible to obtain information from this mode of transport.

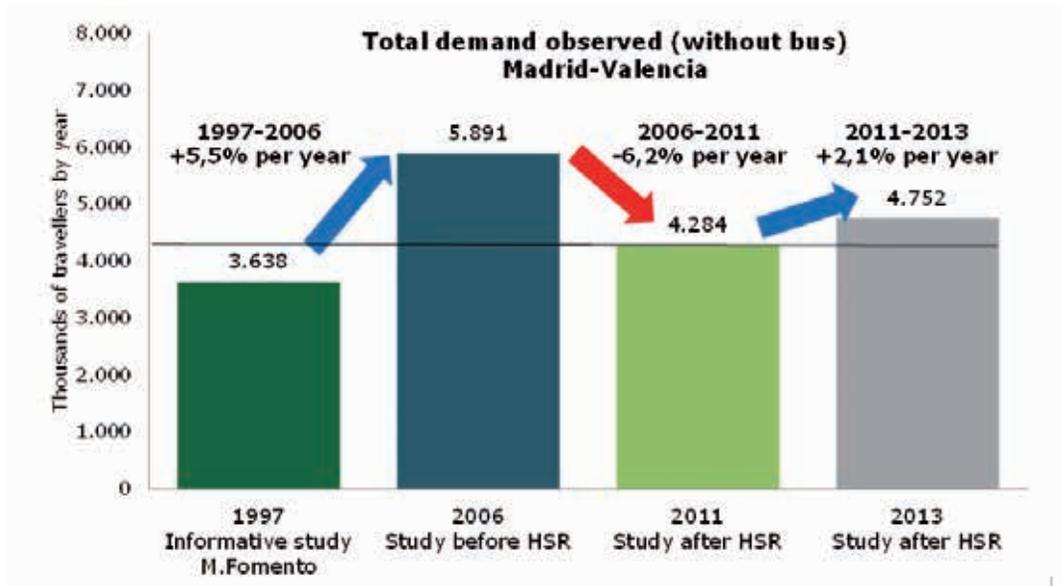


Figure 9. Evolution of annual demand between Madrid and Valencia.

4.2 Madrid-Alicante

In the case of the Madrid-Alicante, the growth between 1997 and 2006 was lower than in Valencia, although it grew significantly at a rate of 3% per year. The economic crisis of the period 2008-2013 has reduced the demand at a rate of 4.2% per year, observing, as in Valencia, a recovery from 2013 onwards, higher than the one experienced in Valencia and at a similar rate to the pre-crisis period, growing 3.3% in the last year with data available.

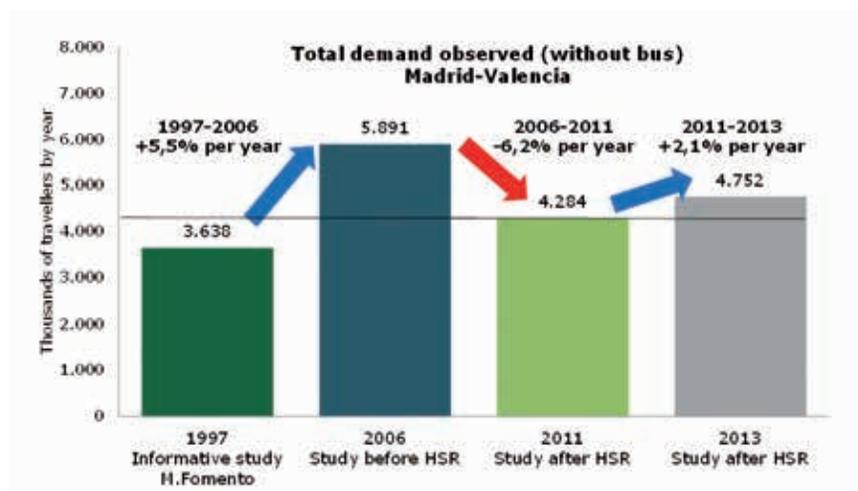


Figure 10. Evolution of annual demand between Madrid and Alicante.



4.3 Madrid-Galicia

Between Madrid and Galicia, the total number of passengers in all modes between 2007 and 2016 fell at a rate of 1,4% per year.

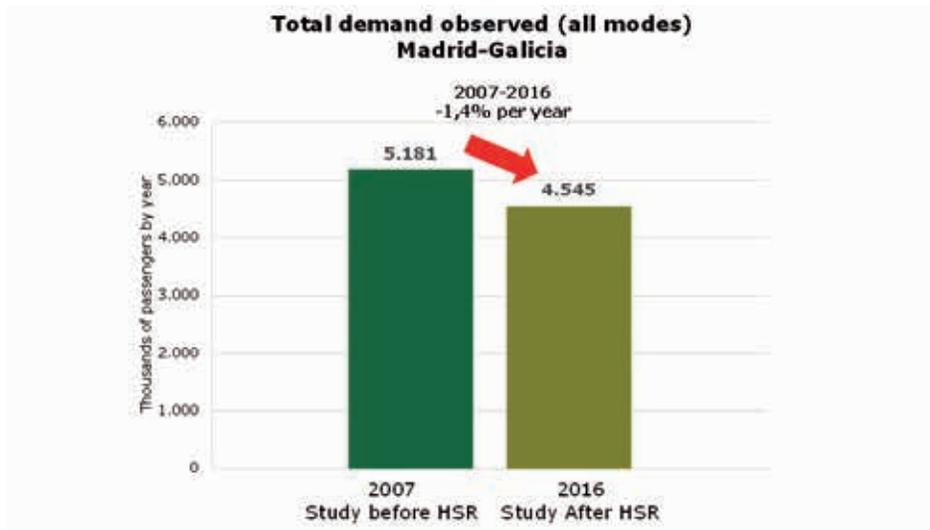


Figure 11. Evolution of annual demand between Madrid and Galicia.

4.4 Madrid-León

Between Madrid and León, the total number of passengers in all modes between 2007 and 2015 grew at a rate of 0,6% per year.

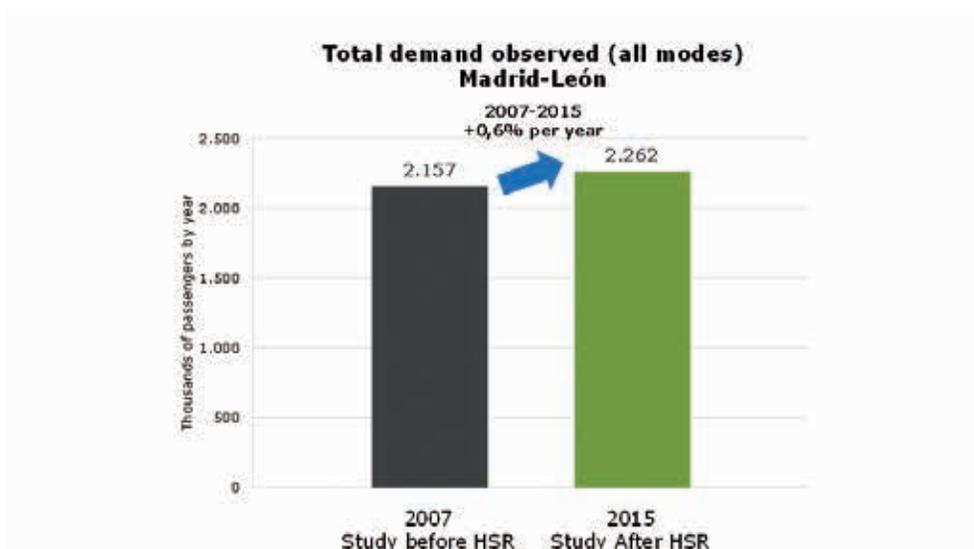


Figure 12. Evolution of annual demand between Madrid and León.

4.5 Madrid-Asturias

Between Madrid and Asturias, the total number of passengers in all modes between 2007 and 2016 fell at a rate of 1,2% per year.

5. Effect in modal share

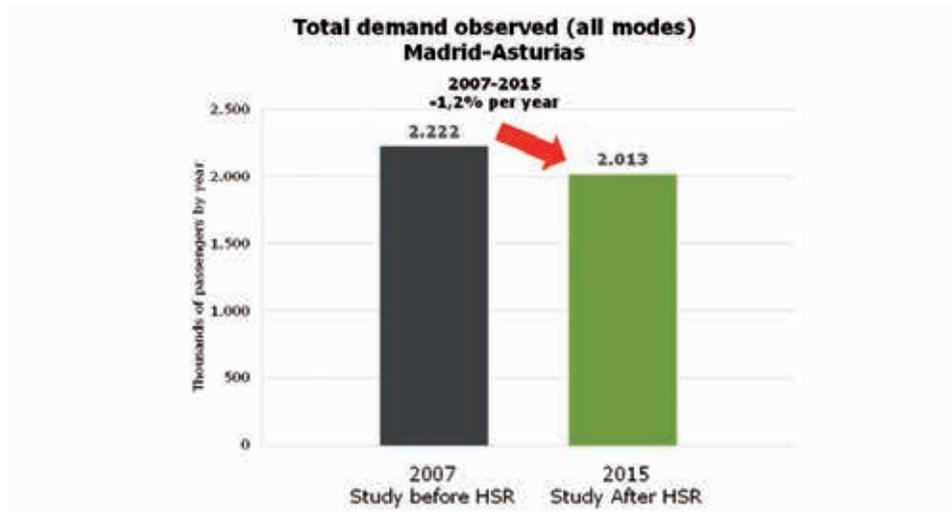


Figure 13. Evolution of annual demand between Madrid and Asturias.

5.1 Modal distribution: Madrid-Valencia

The new HSL has led to a considerable increase in the market share of the railway mode (from 11.4% to 34.8%). This increase is accompanied by a significant fall of car and airplane as expected in previous studies. The share of bus seems unaffected by the appearance of the HSR in 2011, although the difficulty of obtaining information does not allow for obtaining a clear conclusion about the real effects of HSR in this mode. In the campaign 2013/2014 it was not possible to carry out surveys to bus users.

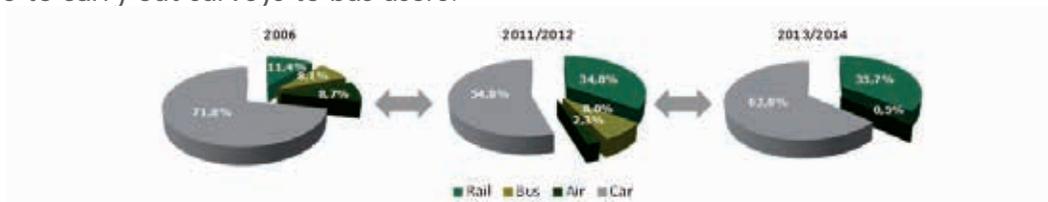


Figure 14. Comparison of modal shares in 2006, 2011 and 2013. Madrid-Valencia

5.2 Modal distribution: Madrid-Alicante

In the case of Madrid-Alicante relationship, there is a notable increase in modal share, but less than in Valencia, from 16% in 2006 to 27% in 2014 (with the HSL finalized). In this case the data are presented without bus, because it was not possible to obtain the demand in this transport mode.

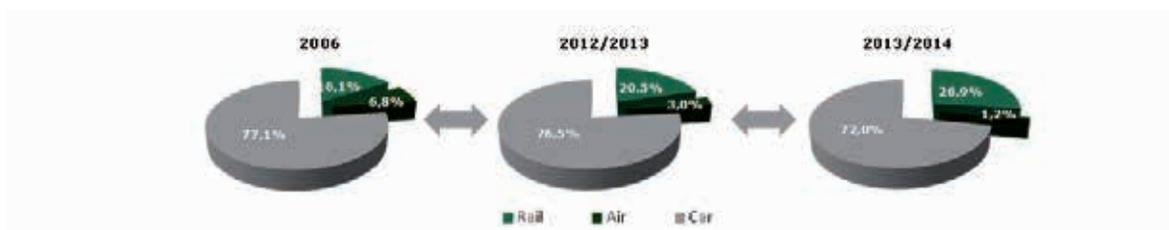


Figure 15. Modal share in 2006, 2012 and 2014. Madrid-Alicante

5.3 Modal distribution: Madrid-Galicia

In this relationship, the HSR has not reached the percentage of the total demand as in Valencia and Alicante, logically because the HSL is not finished, but the rail modal distribution has increased significantly.

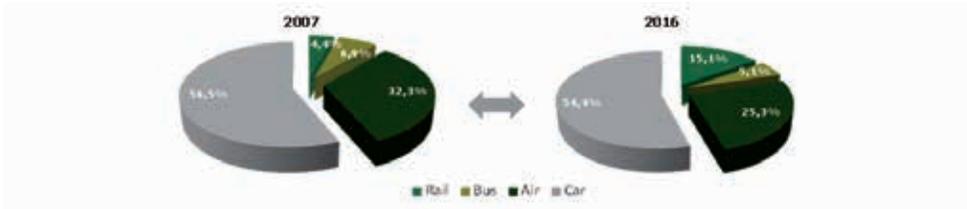


Figure 16. Modal share in 2007 and 2016. Madrid-Galicia

5.4 Modal distribution: Madrid-León

In this relationship, the main effect is the disappearance of airplane.

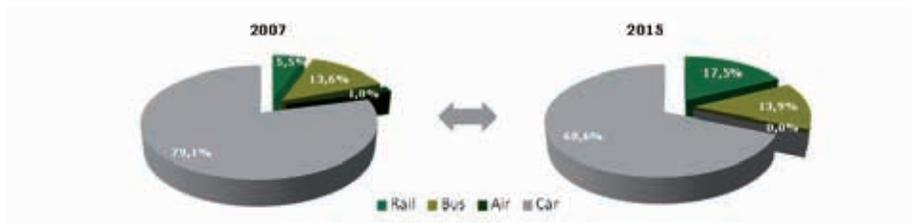


Figure 17. Modal share in 2007 and 2015. Madrid-León

5.5 Modal distribution: Madrid-Asturias



Figure 18. Modal share in 2007 and 2015. Madrid-Asturias

6. Origin of HSR passengers

According to the data obtained in the surveys conducted between Madrid and Valencia, HSR captures the following percentage of the existing modes:

Car: 14%	Bus: 18%	Airplane: 73%	Conventional rail: 32%
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The following graph shows the HSR frequent passengers' response on how they were doing the trip before the HSL was put into service, with a high percentage of "not doing this trip", with 22,6% of the trips, part of which they would be passengers generated.

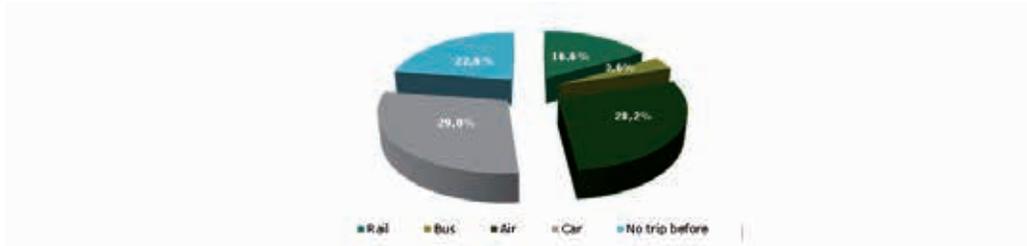


Figure 19. Origin of HSR frequent passengers in 2013/14. Madrid-Valencia.

In the case of Madrid-Alicante relationship, the percentage of frequent passengers who answered "did not make this trip" decreases to 10%, highlighting the origin of the railway mode with 47% of travel.

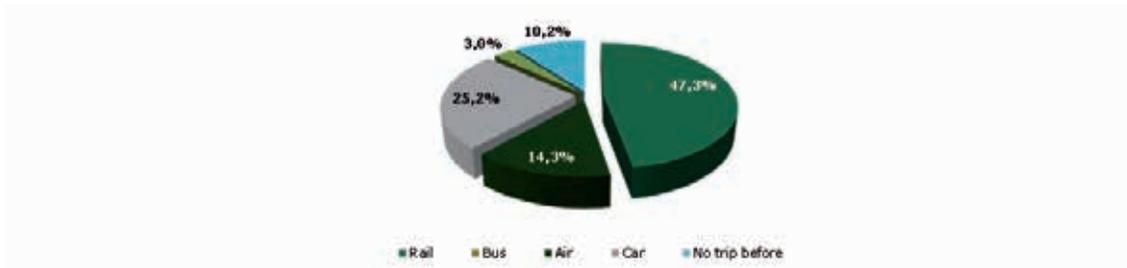


Figure 20. Origin of HSR frequent passengers. Madrid-Alicante.

7. Comparison with forecasting

As it can be seen from the global data, the mobility observed in 2013 is much lower than in the forecasting study, before the high-speed line was put into service. In the study carried out in 2007-2008, models of growth of mobility were estimated from economic variables such as employment and GDP, which, as already mentioned, have had a much lower evolution.

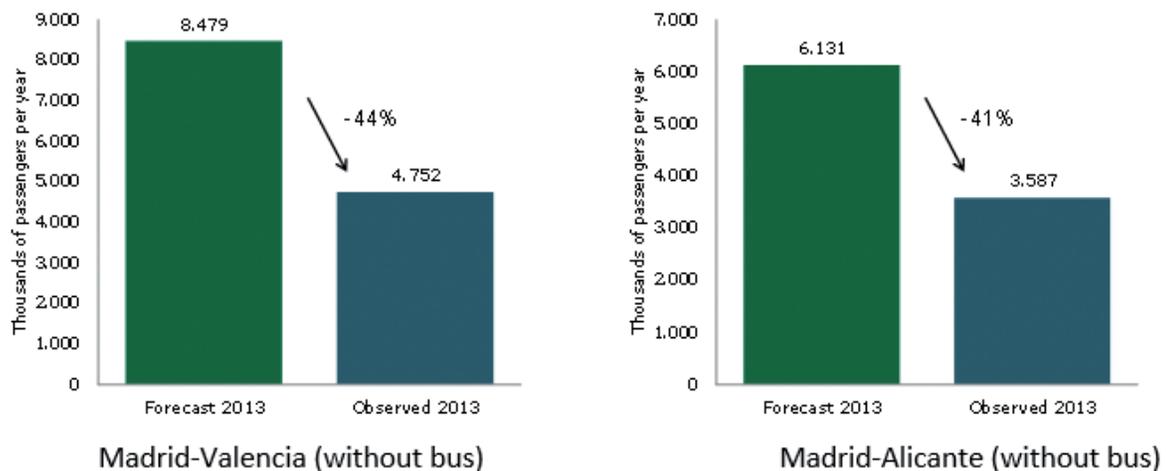


Figure 21. Comparison of forecast and observed data.

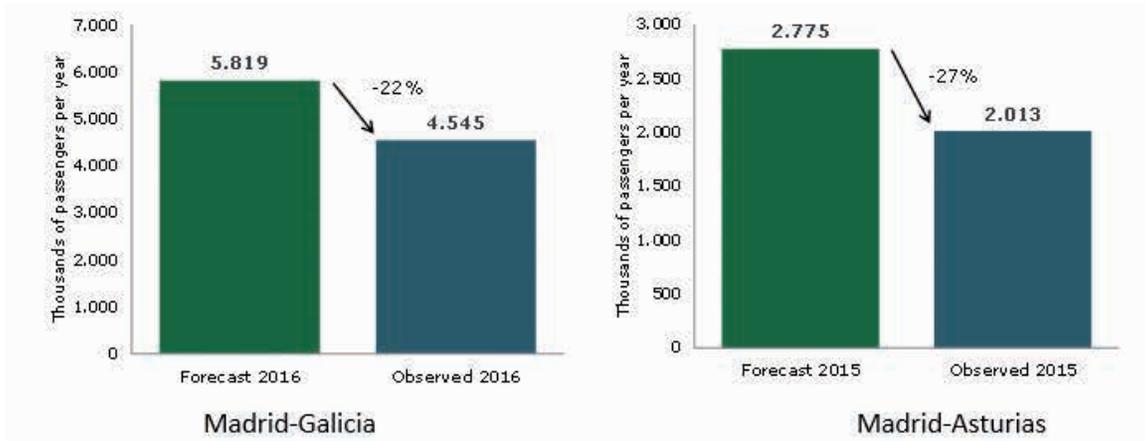


Figure 22. Comparison of forecast and observed data.

The following subchapters show the comparison of modal distributions, where the models have been more realistic.

7.1 Madrid - Valencia

Although the current demand between Madrid and Valencia is 45% lower than estimated in the forecasting study, the modal distribution resembles what was predicted:

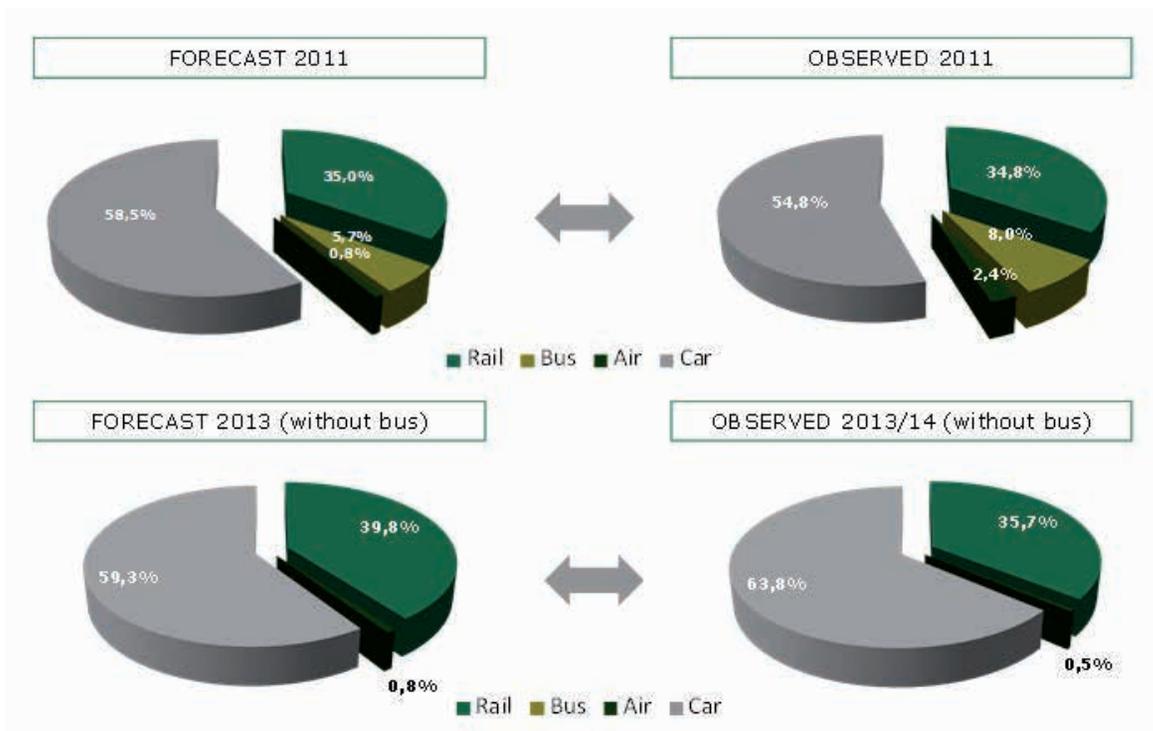


Figure 23. Comparison of expected and observed modal share. Madrid-Valencia.

7.2 Madrid - Alicante

Between Madrid and Alicante the modal share is lower than estimated, getting a worse fit than in the case of Valencia.

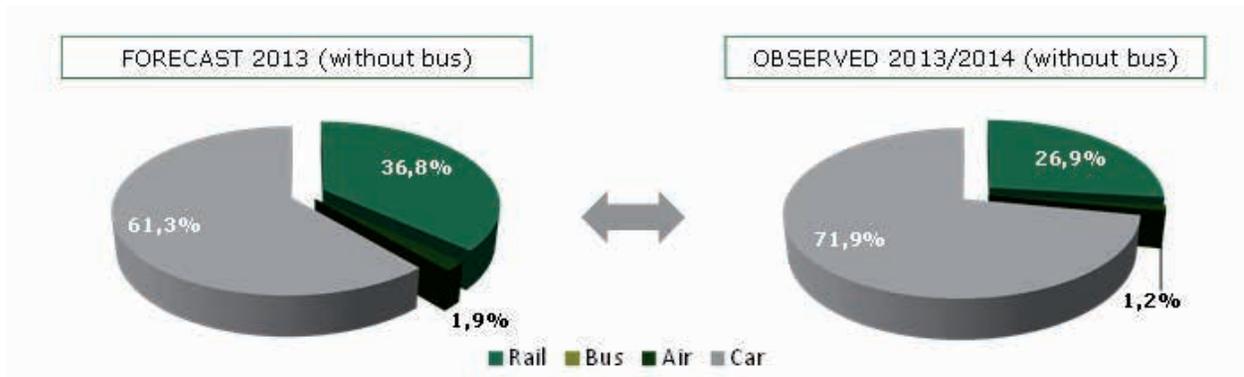


Figure 24. Comparison of expected and observed modal share. Madrid-Alicante.

7.3 Madrid - Galicia

In this case, the participation of rail is slightly higher than the forecast.

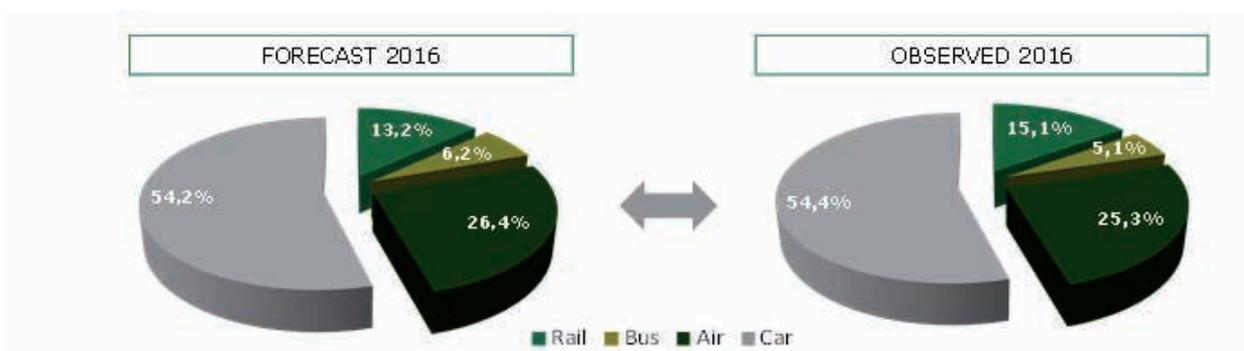


Figure 25. Comparison of expected and observed modal share. Madrid-Galicia.



7.4 Madrid - León

Between Madrid and León the participation of rail mode is practically the same as it was predicted.

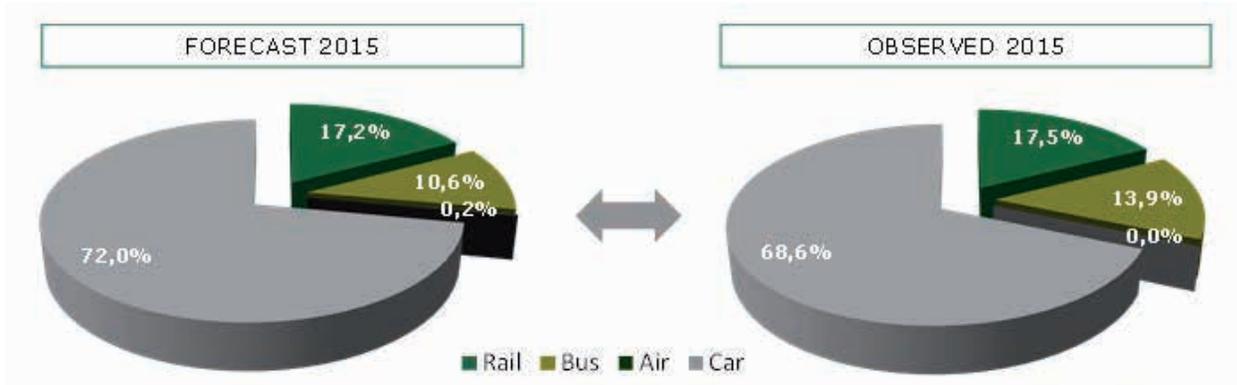


Figure 26. Comparison of expected and observed modal share. Madrid-León.

7.5 Madrid - Asturias

In this case, the participation of rail mode is lower than the forecasting, because the expected travel time is also slightly worst.

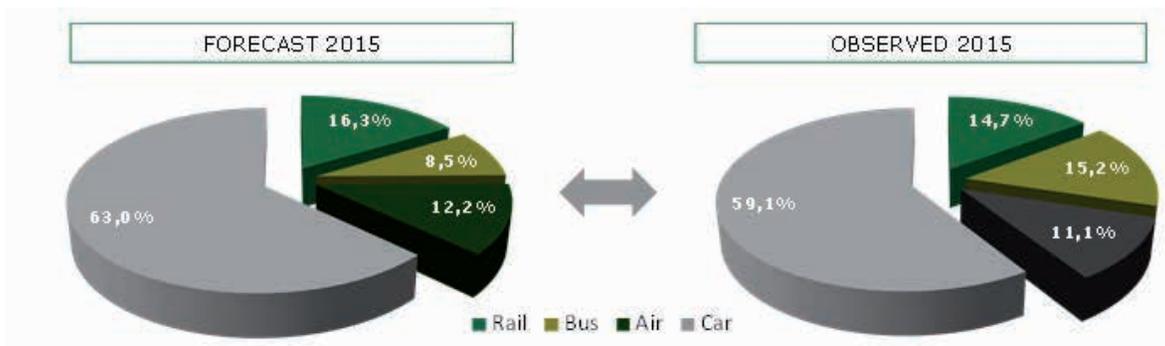


Figure 27. Comparison of expected and observed modal share. Madrid-Asturias.

8. Conclusions

The main conclusions drawn from these analysis are the following:

1. **A new HSL substantially modifies the modal split, observing that:**
 - The most affected mode is the airplane, whose participation in the demand decreases drastically, basically maintaining only connection traffic.
 - HSR reaches a participation between 25% and 35% of the trips.
 - Car is still the majority mode, with more than half of the trips.
2. **A great percentage of frequent passengers did not travel previously, 22,6% in Valencia and 10,2% in Alicante.**
3. **Regarding the economic crisis effect, we can observe:**
 - Total mobility was in 2011 at the level of the year 2000, what is known in economy as "lost decade".
 - As of 2013/2014 with the recovery of the economy, it is observed that mobility returns to positive growth rates.
 - Analysis of the evolution of demand before and during the crisis has seen a greater dynamism in Valencia, with strong growth both before the crisis (+ 5.5% per annum) and during the crisis (-6.2% annual).
 - In the case of Alicante, where this dynamism of mobility is lower, there is a greater recovery after the crisis than in Valencia (+ 3.3% vs. 2.1%).
4. **Studies of forecasting passenger demand between Madrid and Levante carried out before the new HSL estimated quite accurately the modal share with HSR, but due to the economic crisis the forecasts of global mobility have not been fulfilled.**

9. References

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