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Spatial equity and high speed trains: the example of France

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Abstract

This paper is aiming at qualifying the high speed trains in operation in France, with regards to spatial equity. To that end we begin by examining some of the various concepts enclosed in this polysemic word. Increased accessibility was one objective of the development of high speed rail. Thus we estimate a simple model to measure the possible effect of high speed rail on French regions. We did find a positive effect on GDP per capita and demographic growth. In a sense this is because they are growth-promoting that High speed lines are unfair. Beyond that, the pricing system set up by the train operator is based on yield management and intermodal competition. This results in a peculiar and singularly unfair pricing structure. Concerning the funding of HSL, the impacts on equity are highly dependent on the line considered.

1. Introduction

Although transport improvements are growth enhancing, they are probably unfair. Some evidence of unfairness can be found in several effects. Transport improvements often lead to provide extraordinary privileges to some particular places: airports, stations, ports... So it can be considered unfair from the point of view of the places which don't benefit from these privileges (the users and the non-users in the terms of Vickerman, 1997). Conversely, transport improvements are almost constantly sources of negative effects: pollution, noise, severance effects and so on. It follows that the “winners” and the “losers” do not belong to the same place. This raises concerns about spatial fairness. There is no reason to suppose that High Speed Trains (HSTs) are an exception.

Fairness, justice, equity have been the subject of many debates in the 90s. Given the particular context of High speed trains, the question of equity of HSTs has again returned to the

forefront. First we have now enough time elapsed since the inception of the first High Speed Lines (HSLs) in Japan and in France. An appraisal of the spatial effects of HSLs is now possible (Albalade and Bel, 2012). Second, an important country has been building an impressive network of HSLs (China). And third, the US (Levinson, 2012) and UK, until now reluctant to invest in HSLs, are now seriously considering to build their network. Equity matters are the subject of numerous debates in the UK (Preston, 2012). Spatial justice has been at the core of Chinese policy for a long time. In numerous European countries that already have high speed networks, the next HSLs are hotly debated (Spain, France, Italy, Sweden...). The commercially viable links have already been built and the future lines are more or less linked to questionable environmental considerations.

Equity is a polysemic word. In the first part of the paper, we choose the different concepts that will be used in the remainder of the paper. By their very nature HST investments might be considered as inequitable, but to back up this judgment, we have to quantify the effects of the accessibility gains. If the accessibility gains have no consequence, the HST would not be considered as unequitable. So, the second part of the paper is devoted to the consequences of the increased accessibility due to HST. But accessibility has a cost and a price. Thus, in the third part, we consider the fairness of the pricing system and the funding procedures. If the fairness of HST is questionable, we ultimately ask the question of the availability of other modes in conclusion.

2. Equity or fairness in transport expectations

Equity is frequently considered with regard to the seminal work of Rawls (1971). But the rawlsian concepts cannot easily be applied to spatial analysis. Hay (1995) defines eight concepts of Equity Fairness Justice (EFJ) with the design to carry out spatial studies.

The first is “Procedural fairness”. This concept consists in Uniform application of the rules, without questioning the rules. This means consistency over time and space. The difficulty in applying the concept of procedural fairness to HSTs is that the rules are fairly flexible. The same rule doesn’t apply everywhere. So, even if it distorts the concept, we consider that there is no procedural fairness if a rule doesn’t apply everywhere with a reasonable spatial uniformity.

Fulfilment of *legitimate* expectations. We add legitimate as an attribute to the expectations, with respect to the definitions of Hay (1995). Regarding HST, some very optimistic expectations can be observed. High speed is sometimes seen as the magic wand. We have to admit that this concept might be confusing as it could prove difficult to determine the extent to which an expectation is considered legitimate.

Formal equality is a straightforward concept: like benefits (or burdens) are enjoyed (or suffered) by like persons. Obviously, depending on their location, citizens benefit more or less from the establishment of a HST. Formal equality is linked to the possible balance between the poor accessibility and the potential compensations and conversely between the better accessibility and the price paid for it. This concept is linked to the pricing system and the funding of HST.

Substantive equality means equality of outcomes (net benefits minus net burdens). This has to be linked to the balance between what the travellers pay and the benefit of their travel. Once again funding of HSL is to be taken into consideration.

Equality of choices. By its very nature, a new infrastructure alters the choices of the customers. We consider in this paper, that HSTs are unfair according to this concept if a

significant number of customers have a smaller number of choices after the HSL has been established.

In accordance with merits (meritocracy). Some people might benefit fortuitously from any transport improvement, possibly to the detriment of others. It might be some firms or some private individuals. Such situations are frequently found in the transport sector.

Rights. This concept might not be very relevant for our study. HSTs do not particularly breach fundamental rights of the citizens. Maybe, funding can be considered, but if we consider that we live in democratic societies, the central and local government decisions should be considered as not breaching the rights of the citizens.

Corresponding to the needs “Certain needs are so basic that failure to meet them is an injustice”. We can consider that HSTs are not concerned by basic needs. They don’t meet basic needs and they don’t prevent some basic needs to be met. Of course we have the usual effects of building a new infrastructure, but it is not specific to HSTs. To a certain extent the funding of subsidies can prevent some poor people of purchasing some basic goods in quantity or quality desirable (because of the VAT). But this remark is relevant for any subsidisation scheme and is linked to the difficult question of the social marginal cost of public funds. This is clearly beyond the scope of this paper. So, in the remainder of the paper we don’t consider this approach to Equity.

3. Accessibility and regional impacts of HSR in France: polarisation and diffusion

Solving the overcrowding of some rail links was among the objectives of the development of HSLs. But increasing accessibility was also being sought for. To a large degree, both objectives have been achieved in France, for the regions served. These accessibility gains mainly concern the transport time between Paris and some more or less remote regions.

Regarding the regional impact, there is abundance of conjecture but very few ex-post analysis, especially concerning long term effects. The literature on the ex-post assessment of high speed lines is limited to case studies (UIC, 2011). The consensus is that building an HST does not lead automatically to economic improvement of the cities served (Abalate and Bel, 2012; Givoni, 2006). The HST effects can be observed at various levels from regions to station neighbourhoods. The recent researches tend to favour a multi-level analysis (Garmendia et al. 2012; Urena et al., 2009). So far, the majority of the researches have been devoted to cities, Japanese studies excepted (Sands, 1993). In spite of a host of case studies it is still unclear whether HSTs have a true impact on firm’s location decisions, job creation and finally regional productivity. Particularly it is not clear whether the HSTs impacts are limited to major cities or if they extend to a greater region. However, Chen and Hall (2012) found that both the Lille region (Nord Pas de Calais) and the Manchester region have benefited from the HSTs, although not every sub regions.

At the level of regions (provinces) the results of these accessibility gains still remain largely questionable. Indeed, if the effects of HST on major links could be discernible, the intra-regional accessibility might have diminished. Moreover, there is a kind of “tunnel effect” (Plassard, 1991) which consists of poor accessibility for cities located near the HSL, with poor access to the main cities. Moreover, some cities have seen their links to Paris suppressed (FNAUT, 2011).

3.1. The hypotheses of the model

It is interesting to address the effect of the HSTs at the regional level (France is divided in 22 regions) for the following raisons:

- 1) The choice of this geographic level enables us to have economic and demographic data unavailable at a lower level;
- 2) The spatial spillover effects between the statistical units are limited;
- 3) Rail transports between cities belonging to the region are organised by the regional assembly;
- 4) Some regions have HSTs and some have not, this enables comparison.

It is useful to describe briefly the French “*Régions*”. The French regions are frequently spatially organized around a regional capital. Their areas are comparable to a small European country, between Luxembourg and Switzerland. Apart from the Parisian Region and Corsica, their populations are between 1.8 million and 6.2 million. They are not homogenous as they have large cities and rural areas. But since the inception of French HSLs, the bulk of the population travelling inter-regionally by rail belong to the major urban areas (Bonnafeux, 1987).

The main research hypothesis is thus that we suppose that the regional transport and the diffusion of the HSTs in regions permit to irrigate the regional territory. To test this hypothesis we examine whether the benefit of greater accessibility is discernible with macroscopic data such as GDP or population. This has to be done in the long term, because a small growth differential can lead to a large effect over a period of 20 years. We have thus two hypotheses:

- 1) The effects of HST can be observed at the regional level;
- 2) Long term effects are observable (over several decades).

The data offered by INSEE (French statistical bureau) consist of GDP and population for the 22 (metropolitan) French *Régions* on the period 1990-2011.

TGV is the French acronym for HST. In the paper we will use indifferently TGV or HST.

The French TGVs were put into operation as follows (**Fig. 1.**):

- 1981 and 1983: South-East TGV (Paris-Lyon)
- 1989-1990: TGV Atlantic toward Britany and Aquitaine
- 1993: TGV North, toward Lille and later London, Brussels and Amsterdam
- 2001: TGV Mediterranean between Lyon and Marseille and Montpellier
- 2007: TGV East, toward Strasbourg.

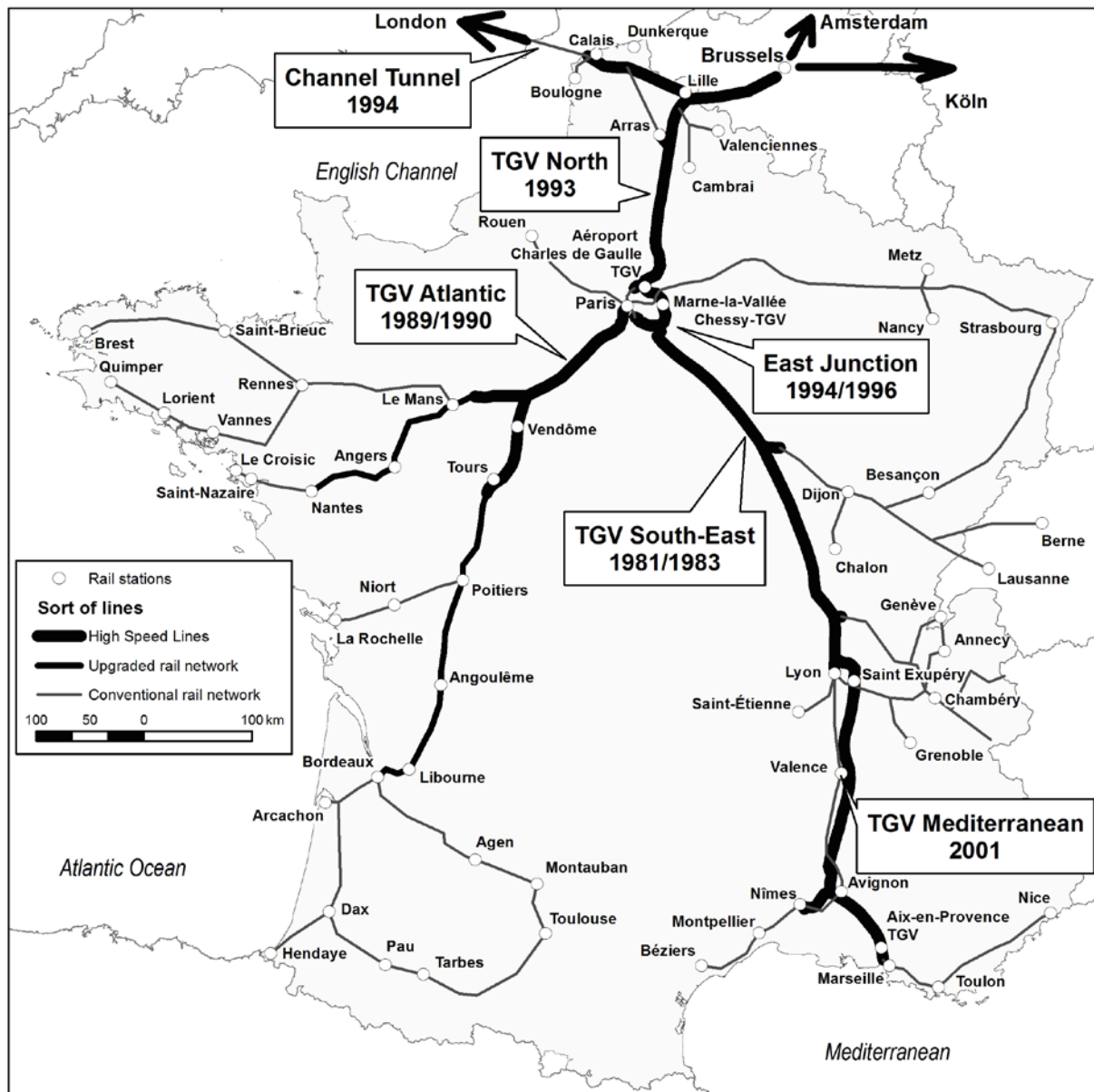
To capture the long-term effects, we chose to include only the TGV network open by December 2007. For this reason, we have excluded the East TGV, put into operation in 2011. But, we decided to include the TGV toward the Mediterranean Sea, although 2007 is close to 2001, because the Mediterranean regions have benefited from speed increases gradually, as shown by table 1.

Table 1. Travel time between Paris and Marseille.

Year	1954	1962	1969	1981	1994	2001
Travel time	8h03	7h10	6h40	5h30	4h14	3h00

Source: Leboeuf, 2014.

Fig. 1. High speed lines and rail network in France in December 2007.



Source: Adapted by I. Baraklianos from Vickerman 1997. This is a selection of the relevant lines (French network extension is actually 30 000 km, around half of them are not used).

These accessibility gains were not limited to very large urban areas. For technical reasons, HSTs can be operated only on specially designed tracks, if they have to run at high speed. But at ordinary speeds they can also be operated on “classical” tracks. Thus a significant number of medium or small cities can be served. It follows that the accessibility gains can be spread on a large scale.

We can exemplify this diffusion of accessibility gains by looking at the Brittany region. Brittany is both a peripheral region and also one of the poorest in France (with a GDP per capita 20% lower than the average of France), and yet, thanks to its classic railway connection with the TGV network, most of the Brittany inhabitants enjoy strong gains accessibility with Paris (Fig. 2). This is important because it allows direct journeys to Paris, but with coaches, the region is even better served.

Fig. 2. The high speed diffusion benefit in some peripheral region: the case of Brittany.



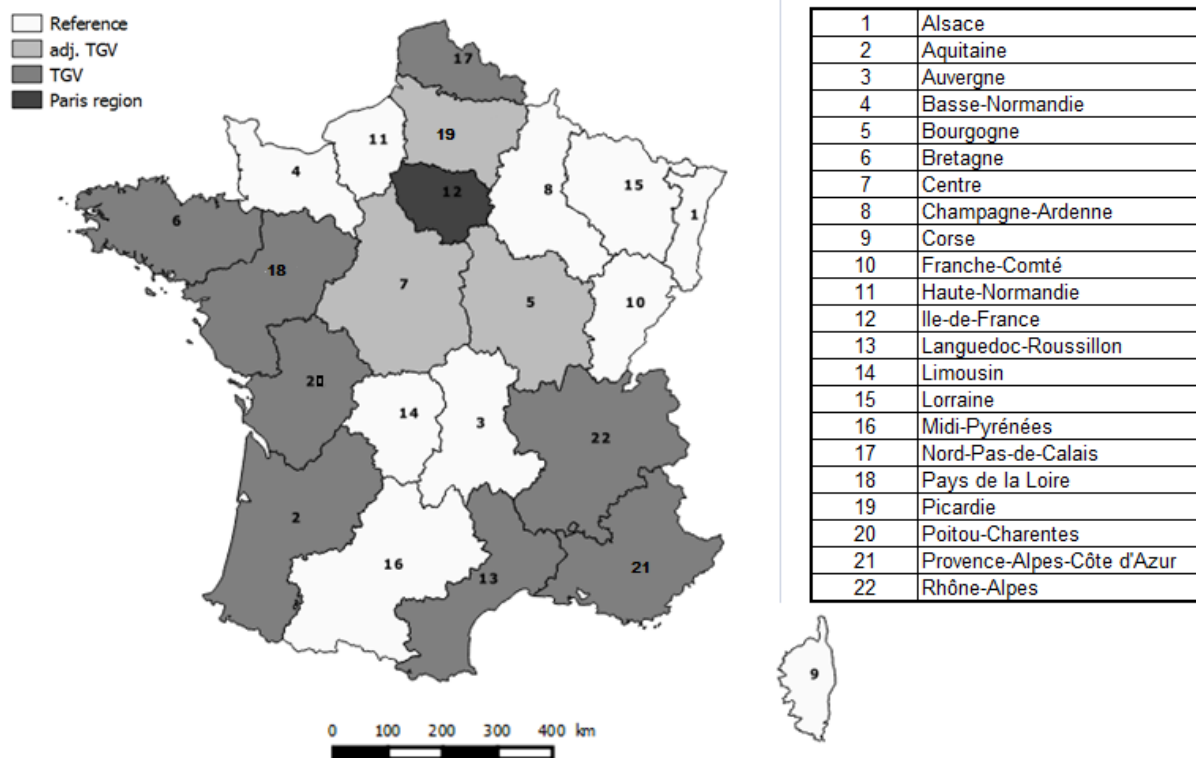
Source: Adapted by I. Baraklianos from RFF.

To measure the regional effects, we grouped the French regions in three categories:

- The regions without TGV (which will be referred to as 'Reference');
- The regions with TGV and adjacent to Paris (which will be referred to as 'TGV adj.');
- The regions with TGV and not contiguous to Paris (which will be referred to as 'TGV').
- Paris region (Ile-de-France) is left outside the sample of regions.

We have decided to separate the analysis of the regions adjacent to Paris for several reasons. First the relative gain of accessibility is smaller than for the other regions. Secondly there is probably more trans-regional commuting with Paris and we would like to avoid this complex issue (see Andersson et al. 2009 for the Taiwanese example, Vickerman 1997, Vickerman 2015 for Europe and France). Thirdly, the HSLs serve only part of the region, and for some cities the former rail link to Paris has been worsened or even abandoned. Finally, as the regions are close to Paris, travelling by car could be the preferred alternative for some cities. The list of the French regions with their status according to the TGV dessert is presented in the following map (Fig. 3):

Fig. 3. Region s' class according to the TGV dessert.



Source: The authors, from INSEE, 2007.

First, the GDP per capita will be examined between 1990 and 2007 (the opening of the TGV East). Even if the literature is inconclusive (Barro R. J. and Sala I Martin X., 1991; Dall'Erba S. and J. Le Gallo, 2005), it is necessary to control for β convergence (the tendency of the poorest regions to have higher growth rate). The estimated model is described by the following equation:

$GDP_i = a.D_1 + b.D_2 + \beta \ln (GDP_{i0})$, where:

- i denotes the region
- GDP_i is the growth of the GDP per capita in region i divided by the growth of the national GDP during the period
- GDP_{i0} is the initial per capita GDP of region i
- D_1 is a dummy equal to 1 if the region is a TGV region zero otherwise
- D_2 is a dummy equal to 1 if the region is a TGV adj. region zero otherwise.

3.2. The results of the model

The results with of the regression are presented in table 3.

Table 3. Regression of the relative growth of the regions served by TGV.

Coefficient	Value	P value
a.	0.06	0.02
b.	-0.066	0.08
β	-0.13	0.15

The data are consistent with a GDP per capita growth for the TGV regions significantly higher than the no TGV regions (reference), around 6%. The GDP per capita of the TGV adj. grew less (6.6%) than the reference. The hypothesis has turned into a result. This result is not very strong because of the small number of region TGV adjacent to Paris.

The hypothesis of β convergence is not supported by the data. But it is useful to keep the convergence hypothesis in order to control for this tendency. Some other specifications of the model did return a significantly negative β .

The difference between TGV regions and TGV adj. regions is important: 12.6% over 17 years. We estimated a control model with creating a new dummy grouping the five adjacent to Paris regions. The results were the same but the coefficient was not significant at the 10% level. So, we cannot be sure that there is a tendency, for the regions which share a border with Paris to have a smaller growth rate in terms of GDP per capita. Taken together, the five regions adjacent to Paris do not exhibit a slower trend in the GDP per capita growth. Thus it is limited to the TGV adj. regions. This effect is not without previous observations and analysis (Vickerman, 2015).

Regarding demographic growth, the results are presented in table 4.

Table 4. Regional demographic growth in France.

Group of regions	Growth 1990-2007 (%)
France (metropolitan)	12.5
Paris (IDF)	12.5
TGV regions	16.3
Non TGV regions	8,4
TGV adj.	6.1
Champaign	-0.1
Higher Normandy	6.4

We have added to the three previously identified regions categories, two adjacent regions with no TGV (Champaign and Higher Normandy. From this table, we can infer the following:

- Demographic growth is the largest in 'TGV regions';
- Demographic growth is le smallest in 'TGV adj.' regions and in adjacent regions as well.

The evolution of GDP combines the evolution of population and of GDP per capita. The results are summarized in table 5.

Table 5. GDP per group of regions.

Group of regions	Growth 1990-2007 (%)
France (metropolitan)	38.3
Paris (IDF)	39.5
TGV regions	43
Non TGV regions	32
TGV adj.	28
Champaign	27.5
Higher Normandy	33.6

The data summarized in table 5 are compatible with a concentration of growth in the TGV regions. TGV regions grew by nine points over non TGV regions (not adjacent). The TGV regions grew more than 3.5 % (expressed in percentage of base year) than Paris.

This leads to a general conclusion on the effects of accessibility gains (mainly to Paris) for the regions served. Data are consistent with a polarisation effect which favours the concentration of economic and demographic growth in some regions. The regions without high speed rail are somewhat “left out”. The regions adjacent to Paris are even more left out. This is consistent with previous observations and analyses, notably Vickerman (1997, 2015)

It is interesting to note that the GDP of Paris grew more than the French GDP but less than the GDP of the TGV regions. This fact doesn’t support the fears, expressed in the 80s, that Paris would benefit the most from the HSLs. To the contrary the data are consistent with a “diffusion” process; Paris being the major node of the knowledge based economy, and the TGV regions benefiting from this engine.

3.3. The issue of accessibility gains regarding equity

Through this improved accessibility provided by HST, some privileges are created. By its very nature a HST is not a fair investment. More precisely, we can consider the HST accessibility effect with regards to the previously defined concepts of equity.

The concept of procedural fairness is not relevant for this accessibility gain. The decision to invest in a HSL is more a question of bargaining than a matter of applying some rules. If there is a rule, it could be that the highest traffic is sought together with the alleviation of rail congestion.

Equity as fulfilment of expectation is more relevant. If we consider what we called the TGV adj. regions, they could have expected that being served, at least partly, by the TGV should have had a beneficial effect on the GDP or the population growth. That is not the case. So we can judge that their expectations are not fulfilled. To the contrary, it seems that the TGV regions (not adjacent) have benefited from the HSLs. In a certain way, this is consistent with the expectation of the majority of people living in those regions. But we have to be cautious; HSLs might have given rise to some new way of life and some urban pattern that not everybody would have expected. In particular, if you don’t use HSTs, you are facing some side effects (rent, congestion, noise...) without benefits.

The concept of formal equality leads to judge the TGV investment as not fair: some comparable citizens of two cities are facing different prospects, depending if they are served by HSTs or not. The mere fact to be located in an important node of a busy corridor gives the right to enjoy the benefit of an HSL. The inhabitants of the chosen locations might benefit from a number of advantages if we trust the assumptions, consistent with the data, that HSL brings wealth and positive demographic evolution. A positive rent evolution might appear as windfall for some inhabitants, a detrimental for some others (also the question is complex). This is not special to HSLs. To a certain extent this is true for any transport improvement, but in the case of HSLs, the effects could be region-wide.

For the same reason, HST might be considered unfair according to the substantive equality concept or the equality of choices. Indeed some “classical” trains have been suppressed, to the detriment of some small cities. Regarding meritocracy, the high speed lines were chosen according to the potential traffic, this is not linked to any kind of merits. According to the consensus, a strong commitment to regional development is required in order to benefit from the economic and demographic impact of HSR. This can be seen as a form of “meritocracy”.

In the French context, a better accessibility generally means a better accessibility to Paris. But that is not the only result. For example, the primary benefit from the TGV between Lyon and Marseille has been to favour travel between Paris and Marseille. But the new line provided more possibilities to improve some local and regional connections. Beyond that, there is a systemic effect associated with any HSL. We have to recognize that our macroeconomic picture doesn't capture fully this systemic effect. However this doesn't diminish very much the unfairness of HST, to the contrary.

The polarization of the national territory caused, among other factors, by the TGV has been previously noted (Monzon and al. 2013, Vickerman 97). It is not an equitable process as expected by Martinez Sanchez Mateosa and Givoni (2012). However if the diffusion hypothesis is confirmed, it is possible that the HSLs contribute to a more balanced territory as regards the weight of the capital. To a certain degree this improved accessibility might have caused both polarization and diffusion toward some privileged regions. But very much depends on the funding of the infrastructure and the price paid to use the HSTs.

4. Pricing and funding policy

To obtain a global point of view of the impact of HST on spatial equity, we need to consider the pricing and funding aspects.

4.1. Pricing policy: empirical evidence

We used the SNCF web site to compare some prices for different sorts of travels. First we compare the link between Paris and Lyon, Nantes, Marseille, Montpellier and a smaller city not too far from Paris: Le Mans. Then we address the question of travelling between Lyon and some southern cities: Valence, Marseille and Montpellier. Finally we investigate the link between Lyon and Lille (in the North) and Nantes (in the West). The later rail journey implies to bypass Paris.

The results are presented in table 6. All the following prices are calculated for second class without any reduction.

Table 6. Prices sample.

From	To	1 month discount	4 month discount	Length (road)	Cents per km (1 m disc.)	Cents per km (4 m.disc.)	Ratio 1 m / 4m
Paris	Lyon	92	30	466	19.7	6.4	3.1
	Le Mans	31.6	20	212	14.9	9.4	1.6
	Strasbourg	71	71	492	14.4	14.4	1.0
	Nantes	47	20	381	12.3	5.2	2.4
	Lille	26	15	221	11.8	6.8	1.7
	Montpellier	71	37	750	9.5	4.9	1.9
	Marseille	57	40	777	7.3	5.1	1.4
Lyon	Nantes	143.2	60	723	19.8	8,3	2.4
	Valence	18	14.3	104	17.3	13.8	1.3
	Lille	111.5	45	692	16.1	6.5	2.5
	Marseille	47.3	47.3	315	15.0	15.0	1.0
	Montpellier	27	20	303	8.9	6.6	1.4

Source: SNCF web site, visited on the 8th of May 2013. All these prices are relative to trains whose departure is between 6:15 and 6:30, only on Tuesdays. Distances are calculated with “Mappy” web site. For this investigation, we consider the HSL toward East (Strasbourg).

About HST pricing, we observe four main results.

a) Tickets purchased four months in advance are always much cheaper than the ones bought only one month before (for the same origin-destination). The difference could be really huge, for example for Paris to Lyon, 30 Euros versus 92 Euros. The differences can be observed for all destinations (last column of table 6). In contrast a few other links offer no discount due to the date of the purchase, e.g. Paris-Strasbourg and Lyon-Marseille. In average, on our sample, the ticket bought one month before are 80% more expensive than the same destination purchased four months before.

b) The second observation is that, regarding TGV, SNCF’s fare structure is not cost oriented. The average price of the TGV kilometre is highly variable, depending of the O-D and the date of purchase. By example, purchased one month in advance, the Paris-Marseille (777 km) is less expensive €57, than the Paris-Lyon, €92 (446 km). Indeed Paris-Lyon appears to be a “cash cow”. We can wonder if the Paris-Marseille line is profitable. This results in a transfer of well-being between Lyon’s region and the rest of France, particularly Marseille.

c) Considering the price per km, there is a huge difference between the highest (€19.7) and the lowest (€7.3). The most expensive, from Paris, is about 2.7 times more expensive than the cheapest one. HST’s fare structure seems to be oriented toward revenue maximisation which is probably due to yield management adopted by SNCF (the train operator).

d) We can observe that some links are submitted to very high fares (Paris-Lyon and Paris-Strasbourg). Is it monopoly pricing? On these links, there is no intermodal competition: the distances are too large for cars and too small for airlines. In the vocabulary of business management, we can call them “cash cow”.

4.1.1. How to explain these pricing results?

In contrast with others domestic passengers' fares, today pricing TGV operates on the principles of yield management. SNCF was the first railway company in the world to implement yield management. Taken from the airlines (American Airlines for the software used by the SNCF) yield management is based on occupancy across time (Smith and al., 1992). Thus, when the departure nears, the price goes up; the same principle applies with occupancy rates. However, there are some rules.

a) The prices paid by users are set on the basis of regulated fares corresponding to the reference price of travels in second class;

b) Tariff’s Modulation is left to the discretion of the railway company, but limited by ceiling between plus and minus 40% of the reference price;

c) SNCF must provide available discounted tickets to customers, corresponding to a percentage of the total annual ticket sales.

The issue of the reference price is crucial. In practice, there is not a single price ceiling for all TGV, but as many prices as routes. For HSR, the key factor of the SNCF’s pricing, is clearly the potential of intermodal competition (airlines, coaches in the future). Thus, airlines competition explains smaller prices (Paris-Marseille much lower than Paris-Lyon).

Overall, HSR’s SNCF fares are subject to various constraints: obviously, intermodal competition and the huge fixe cost (to renewal of rolling stocks). In Europe, operators are

separated from infrastructure management and are requested to pay infrastructure charges. These charges impact the fares.

4.1.2. The issue of equity

Regarding “procedural justice”, HSR clients are facing the fact that there are no apparent rules, apart those deriving from the will to maximise the revenue. TGV’s fares are routinely qualified to be non-transparent by travellers and users associations (FNAUT, 2011). So we can consider that the pricing rules are not applied uniformly over space.

As regards “legitimate expectations”, you can expect that, by booking your ticket four month in advance, you can benefit from substantial discount. This is usually the case, but is not true for every link. You would expect to pay less for a shorter distance. That is not the case as the Paris-Lyon-Marseille exemplifies. You pay more for Paris-Lyon than for Paris-Marseille; and to go from Paris to Marseille, it is necessary to go first in Lyon (450 km) then to pursue to Marseille (about 300 km). The travellers, victim of monopoly pricing can, to a certain point, consider that their expectations are not met.

The “formal equity” is seriously breached. Depending where you depart from and where you want to go, you have to pay very different prices (on a cent per km basis) even for distance of comparable length. For example, from Paris to Montpellier, price is €1 (9.5 c. per km) and from Paris to Marseille, it’s €7 (7.3 c. per km).

Regarding “substantive equality”, we have to be moderate. To a certain extent, the customer who accepts to pay a given price for his travel should assess the benefits and the costs of his purchase. But, sometimes, the customer has no choice, and he/she or his/her firms has to pay, because the alternate transport modes are too expensive or not available. The introduction of the TGV network has been partly at the expense of the conventional rail network. Usually, nowadays, the timetables are less attractive for the travellers departing from these “small” stations, compared with the situation existing prior HSRs.

It is obvious that the “equality of choices” is seriously breached. If you are Parisian and you have a limited amount of money to spend, you better go to Marseille than to Lyon or to Strasbourg. And conversely, to go to Paris, it is better to live in Marseille, than in Lyon or in Strasbourg. If you are a businessman from Lyon, you might prefer to attend a meeting in Montpellier than in Marseille. The use of the web site of SNCF (the train operator) provides some astonishing pictures of the crazy results of a hub and spokes network. For example, Bordeaux and Rennes are two western cities of France, both linked to Paris by HST. Buying a train ticket leads you to take a connection in Paris.

Concerning the “consistency with merits”, once again, the fare structure appears to breach the very concept of equity. If the fare structure is cost related, we could admit that there is a certain justice. But it is not the case. And thus having the merit to be in competition with a low cost carrier (e.g. Paris-Marseille) does not allow you to benefit from discounted fares. Having or not having an affordable alternative to HST is not a merit per se.

About the “rights”, there is, in France a so called “right to transportation” (LOTI, 2002). According to the constraints imposed by the State to the national railway company, SNCF has to offer to its customers a minimum number of tickets below a reference price.

4.1.3. Comparison with others Europeans countries: is there others “Cash cow” HS trains?

We briefly address the question of equitable pricing in three other European railways with high speed: Germany; UK (with the definition of UIC, UK has more than one HSL) and Spain (the longest HSR network in Europe).

We are looking for “cash cow” and “price reversal”, applying the same methodology than for France.

Table 7. Prices examples of HSR’s destinations in others European countries.

		Price 1 month discount.	Price 2 months discount	Distance (road, km)	Cents per road km 1 month	Cents per road km 2 months	Ratio one month to 2 months discounts.
Spain							
Madrid	Ciudad Real	37.2	36.4	204	18.24	17.84	1.02
	Zaragoza	54.6	54.6	314	17.39	17.39	1
	Cordoba	62.1	62.1	387	16.05	16.05	1
	Seville	75.5	75.5	529	14.27	14.27	1
	Barcelona	106.7	106.7	617	17.29	17.29	1
Germany							
Frankfurt	Köln	69	69	192	35.94	35.94	1
	Stuttgart	61	61	206	29.61	29.61	1
	Munchen	98	98	420	23.33	23.33	1
Berlin	Leipzig	46	46	196	23.47	23.47	1
Hanover	Munchen	129	129	631	20.44	20.44	1
UK		Pounds	Pounds	km	Euros c.	Euro c.	
London	Birmingham	14	14	190	8.69	8.69	1
	Manchester	108.5	34	322	39.76	12.46	3.19
	York	30.5	30.5	330	10.91	10.91	1
	Newcastle	28.5	38	446	7.54	10.05	0.75
	Glasgow	54	50	650	9.8	9.08	1.08

Source: National rail inquiries, RENFE web site, Bahn.com, visited on the 13rd of May 2013.

The first observation is that, contrary to France, there is no clear and convincing evidence of yield management in others European countries. The price is usually stable over time for all rail links studied in our sample, with almost no discount price for purchase in advance (Table 7, last column).

Second observation, the existence of Cash cow is not confined to the French HST. This is surprising to find this practises both, in UK, the epitome of free market entrepreneurship and in France the epitome of state owned monopolies. London-Manchester is a perfect example of cash cow, bought only one month before the departure, the price in cent per kilometre is €39.8 for only €9.8 for Glasgow, the total price for Glasgow being less than half of the price for Manchester.

So globally, the pricing systems of HSTs seem not in favour of equity. However, regarding the evolution of the European railway regulation (fourth railway package), we can ponder whether the introduction of competition can lead to a more equitable pricing system. Competition on the track can decrease the prices on the more heavily priced segments (notably Paris-Lyon and Paris-Strasbourg). But such a competition raises numerous questions (Pérennes, 2014).

4.1.4. Is Ouigo a new concept of HST regarding pricing equity?

However, to be complete on the issue of pricing, we have to include in our analysis the impact of the high speed experience at low prices, provided by Ouigo; the SNCF's low cost company, recently launched (April 2, 2013). The target is to attract new customers previously using the car because of a no competitive rail service as compared to car (Ciry, 2014).

This new product is focused only on very busy links: Marne-La-Vallée-Chessy (a suburb of Paris, linked to the centre by suburban rail) to Marseille and Montpellier. There are three return services a day and four on Sundays (62 links a week). In order not to compete with the TGV, the choice of the station in Paris region is Marne-La-Vallée-Chessy. In Lyon, this is primarily Saint-Exupéry, the airport of the city, but connected with the city centre by LRT (Fig. 4).

Fig. 4. Mapp of TGV Ouigo network.



Source: <http://www.ouigo.com/fr/destinations-et-gares> - Visited on the 2 of March 2015.

The prices are really attractive, with fares for the unique class (second-class) ranging from €10 to €85. Children (less than 12 years old), if accompanied by an adult, pay only a flat fare of €5. Moreover, by contract with the State, the SNCF has the obligation to provide 1 million of tickets each year at less than €25 (whatever the distance is). With these low prices, there is no more first class, tickets can exclusively be booked on line and services are limited, with only one piece of baggage free on charge, no bar onboard, and a check in before getting on the train at least 30 minutes before departure. Moreover, the personal tickets are not refundable, except in the event of cancellation of the train and exchangeable with financial penalties. Booking can only be done maximum 10 weeks before the departure. Finally, strong constraint, the half of at the 10 stations served by Ouigo are outside the city and imposes an often important access time to downtowns (in particular at the beginning of Marne-La-Vallée-Chessy, Lyon Saint-Exupéry), or sometimes a significant financial cost.

Table 8. Examples of access to Ouigo stations by public transport from downtown.

Ouigo Stations	Marne-la-Vallée Chessy	Lyon –Saint-Exupéry Airport	Aix en Provence TGV	Valence TGV	Avignon TGV
Access time to the city centre	50' (RER A)	30' (suburban rail, 'Rhône Express')	20' (county Bus)	20' (Express Bus, 'Inter Citéa')	Suburban rail: 5' 4,5 Km by car: 9'
Frequency	15'	15'	15'	15' (rush hour) -60' (off-peak hour)	60'
One way ticket price (excluding any discount)	7.6€	14.6€/ 25.7€ (round-trip ticket)	4.1€	1.2€	1.6€

Source: From various public transport websites - Visited on the 2^d of March 2015.

To have a clearer idea of the fare structure of Ouigo, we realised a study of prices on main trains (Table 9). We obtain the following five major observations:

- Tickets purchased in advance are always less expensive for the same destination as those bought little before the departure, with a going ratio from 1.5 to 2.5.
- Secondly, Ouigo's fares are not cost oriented as we can observe in the similar price of the ticket from Marne La Vallée - Marseille and Marne La Vallée – Lyon for the same hour of departure.
- Potential of demand has a great impact on the price level. It's the reason why there is a higher price for the tickets taken during school holidays (Tuesday 21 of October).
- Such prices are real: three weeks before departure, it's possible to find tickets for quite the all destinations proposed for 10 or 15€, much cheaper than all others transport alternative choice.

Table 9. Prices sample of some TGV's links with Ouigo.

In euros	Tuesday 14 October	Tuesday 14 October	Tuesday 21 October	Tuesday 21 October	Tuesday 4 November	Tuesday 4 November
Marne-La Vallée - Marseille	12:22: 25€	19:26: 30€	12:22: 45€	19:26: 45€	12:22: 10€	19:26: 10€
Marne-La Vallée - Lyon	12:22: 25€	19:26: 30€	12:22: 45€	19:26: 45€	12:22: 10€	19:26: 10€
Marne-La Vallée - Montpellier	11:00: 25€		11:00: 50€		11:00: 10€	

Marseille – Marne-La Vallée	08:25: 15€	16:28: 10€	08:25: 45€	16:28: 30€	08:25: 10€	16:28: 10€
Lyon - Marne La-Vallée	08:35: 20€	17:13: 45€	08:35: 40€	17:13: 50€	08:35: 10€	17:13: 15€
Montpellier – Marne-La Vallée		15:24: 45€		15:24: 55€		15:24: 15€

Source: <http://www.ouigo.com/fr> - Visited on the 10th of October 2014.

To obtain these 'low fares', SNCF has to drastically reduce its operating costs, by 30%. To succeed, SNCF introduced a mix of managerial and technical innovations. The choice of the departure stations allowed to spare on the infrastructure charges, each of the four double-deck TGV Duplex offer a total capacity of 1 268 seats, almost 25% more than a standard TGV. And this material is call to run much more than the others TGV, with much reduced technical maintenance stops. This rolling stock is also intended to be used more intensely than other TGV rolling stock. A new organization of accompanying staff reduces the costs and most of the maintenance is done directly during the trip.

At the end, it appears that the effects of the Ouigo's fares on fairness are important and generally positive. First of all, because of its competitive fares, singularly for the families, the young people and the small groups, Ouigo brings a significant increase of value for money which regards the "substantive equality". Ouigo is sometimes even cheaper than carpooling. Secondly, Ouigo brings a surplus regarding the right to transportation, by providing some affordable journeys. SNCF proclaims than, during the first year, Ouigo had already carried over 2.5 million passengers.

With less than two years of operating, it's too early to make a full assessment of this new HST pricing and these studies remain to be done. Furthermore, SNCF plans to extend the Ouigo network with the opening of new lines toward the Atlantic coast before 2017.

42. Funding policy: empirical evidence

Le last aspect of our study concerned the funding of the HSR network in France from the spatial equity point of view.

4.2.1. The French HST funding

Regarding the French HST funding, two main observations appear. The first result shows the huge increase of the cost of each new HST project and the second result deals with a change in the financers of the projects (Leboeuf, 2014).

Approximately, the first line, Paris-Lyon costed Euros 4.8 million per kilometer (euro in constant value of the year 2003), as compared to €9.3 for TGV Atlantic and €9.5 for North-Europe. More recently, the TGV Mediterranean costs amounts to €17.5 million per kilometer and €16.2 for the new line SEA (South-Europe-Atlantic).

The second result deals with the evolution of contributions of the taxpayers. Since its inception, the HSLs funding became more diverse, including progressively local governments. The analysis shows four specific steps.

In the first HSR investment period, the investments were fully supported by the SNCF budget, mainly by its own cash flow. The operator based its calculations on the hope that the high profitability of these lines would improve the financial health of the company.

On the second period, in relation to the deterioration of the financial position of SNCF, the national railway operator asked and obtained that a share of the funding should be provided through the central government (30% in the LN2, TGV Atlantic).

For the third period, since the creation of RFF (1997), the independent infrastructure manager, funding consists of a mix involving a large subsidy from the State or the European Union, coupled with contribution from RFF and from local authorities. This new scheme can be clearly observed on the financing of the LN6 (East TGV, first stage) and LN7 (Rhin-Rhone TGV).

And at the last and present step, we observe new funding mechanisms, with concession financing for Perpignan-Figueras or with PPP mechanism for the SEA line (South-Europe-Atlantic) with Vinci, one of the main French construction company.

For the last 4 HSL construction projects in progress, on average, public funds represented 55%, RFF is barely 20%, and 25% from private operators. Among these 55% of public funds, 1% is coming from EU, 25% from local governments and 29% from the central government (Table 10, last column).

Table 10. Funding of HSR in France.

	EAST (1)	BPL (1)	CNM (1)	SEA (1)	Total	
					Amount	%
Total cost (million euro)	2 000	3 300	1 800	7 800	14 900	100.0
Length (km)	106	182	80	303	671	
Cost/km (million euro)	18.9	18.1	22.5	25.7	22.2	
Paid by RFF (million euro)	520	1 400	-	1 000	2 920	19.6
Paid by central government (million euro)	680	950	1200	1500	4 330	29.1
Paid by local government (million euro)	640	950	600	1 500	3 690	24.8
Paid by EU + Luxembourg (million euro)	160	-	-	-	160	1.1

Source: RFF.

(1) EAST: second phase of the East European High Speed Line; BPL: Bretagne, Pays de la Loire; CNL: line- Nimes/Montpellier bypass and SEA: South-East-Atlantic.

In short, funding sources have changed rather quickly over the period on which HSL were build. SNCF (state owned operator) withdrew from the investment market to give place to central and local government. RFF, the owner of the track is risk adverse and doesn't want to be involved in risky investment.

4.2.2. Funding and equity

Regarding “procedural justice”, HST funding mechanisms differ depending on the line chosen. This fact introduces spatial inequity. For the “chore three lines” (South East, Western, North) local taxpayers were not solicited. Conversely, “as time goes by”, the new investment was on less travelled lines. Local government are requested to pay their share of the investment. This is the case, notably for the four HSLs now planned or under construction in France (table 10). Political bargaining probably outweighs the economic calculation. So the rules are flexible.

About “legitimate expectation”, the impact of a new high speed line on a regional economy and the wider benefits are very difficult to estimate (part. 3). The local governments (and taxpayers) might not be in line with their expectations. Long term macroeconomics factors are very unpredictable and traffic modelling remains a very difficult art.

As regards “formal equity”, we can observe a huge evolution: the conditions under which a decision to implement a new HS line are tightening over time. Beneficiaries from the first HSL did not directly contribute to pay for the investment (south-East; Atlantic, North), while citizens concerned by the last lines are requested to pay, by local taxes.

For example, for the first stage of TGV East line, local authorities had to pay about 740 million, or 24% of the total. The “Bas-Rhin” (a local district about half of the Alsace region) had to support a funding, equivalent to the Ile de France (Paris), whereas the population of the former is 1.2 million against 11.8 million for the second.

With respect to “substantive equality”, the different HST funders don’t obtain similar net outcome. It depends on the HSL and on the context (demand, macroeconomics...). From the taxpayers’ point of view, with state funding, we saw (part. 3) that the economical and demographical benefits are not similar on the all territory. All people contribute for this infrastructure, but only some of them receive HST benefits. From the local taxpayers’, more and more requested to participate at the funding, the balance is actually unclear. By example, there are no available results to say whether the local communities from Champagne-Ardenne, Alsace or Lorraine had received enough advances given their investments in the HSL/EAST first stage.

Concerning “equality of choices”, there is not equality of (spatial) distribution of choice sets for several reasons. The main reason is the finance public context. Currently, there is not enough public money available to finance the all planed HST lines. Some projects have been blocked, given the unfavourable context (Commission Mobility 21). The second is that some HSL projects may be eligible to the priorities of the European Union, by TEN-T funds (East, first and second phase), others not (SEA). European Union promotes the links between countries (Lyon-Turin). Some areas or local governments have the financial capacity or political will to co-finance the High Speed Rail, some others not..

5. Conclusions

Ninetieth century was the real time of high speed revolution in ground transportation (Whitelegg and al., 1993). This had not entailed very much inequity for two reasons. First the rail networks achieved a dense territorial coverage. A very large distribution of the advantages of high speed ensued. Secondly, in an economy based upon industry, a certain degree of proximity was necessary between the productive activity and the service related to that activity. We are now in a knowledge based economy facing globalisation and digitalisation.

The data are consistent with a polarisation effect. In a sense, HSTs are unfair because they are growth-inducing. As in the ninetieth century, HSL were developed where the growth potential

was higher although a few regions benefited of a windfall. But with a few exceptions, the regions served by TGV are among the most dynamic in France. Surprisingly, although the TGV system is converging toward Paris, the Parisian region doesn't appear to benefit more than the other regions from this central position. We might call this tendency "diffusion" as the knowledge based economy, mainly based in Paris, is creating some benefits for the periphery. So, the spatial impact of TGV is mixed: polarisation, to the detriment of the regions not served, and diffusion of the benefits of the major engine of the knowledge based economy: Paris. However, our analysis is limited to France, although there is a true European network, at least in the North-West of Europe (Vickerman, 1997).

The transfer to the railway pricing system of yield management leads to a peculiar and singularly unfair situation. Fortunately, other modes can compete. Air transport seems to be more efficient than rail for intercity travel (Paris excluded). Moreover, air is not centralized on a major hub (so far for LCCs). For intercity travel in France and in Europe, air travel is more cost effective and faster than rail. This provides a "second chance" for the regions with no HSL. It remains to be seen whether car sharing or coaches could contribute to restore equity. The "green" argument in favour of railways seems to begin to weaken (Westina and Kagesona, 2012).

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