

# HIGH-SPEED RAIL: CALIFORNIA IN CONTEXT

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## SUMMARY

California has been building a high-speed rail (HSR) system from San Francisco to Los Angeles (“Phase I”), with potential extensions to Anaheim/San Diego and to Sacramento (“Phase II”). The project is controversial because of its high (and rising) costs and the financial risks it poses to the state. This paper summarizes the experience of major high-speed rail systems in Europe and Asia and highlights the issues and choices facing the Legislature and Governor as they consider the future of the project. The paper argues that, by comparison with foreign experience, the project has suffered from: unstable and fragmented government(s) oversight; unreliable and insufficient funding; limited managerial capability; incomplete and inappropriate planning objectives; and, delays due to protracted litigation.

## HIGH-SPEED RAIL PROFILES

There is nothing new or exotic about high-speed rail.<sup>1</sup> Even some steam trains in the U.S. and Europe achieved speeds of 200 Km/hr by the end of the 19<sup>th</sup> century, though not in regular service. During the 1960s, experimental gas turbine trains exceeded 250 Km/hr and the United Aircraft TurboTrain actually carried passengers at 250 Km/hr for short distances, although the equipment was highly unreliable and expensive to maintain.<sup>2</sup> The PennCentral electric Metroliners were also capable of speeds above 250 Km/hr, but were constrained in practice to 200 Km/hr in revenue service in the mid-1960s. For the purposes of this paper, “real” high-speed rail passenger service began when the “Shinkansen” trains began to operate over the full 500 Km from Tokyo to Osaka in 1964 at sustained speeds of 210 Km/hr.

**Japan.** The first line of the Shinkansen system (Tokaido) from Tokyo to Osaka was built to carry the added traffic generated by the 1964 Tokyo Olympics as the existing Tokyo-Osaka line was saturated. Since commencing service, the Shinkansen system has been extended to 2849 Km connecting Tokyo to most of Japan’s larger cities (see Table 1 for comparisons). The Shinkansen system is exclusive to HSR and is a different gauge from the rest of the Japanese system. The Shinkansens currently carry nearly 400 million passengers annually. Since 1964, the Shinkansens have carried over 11.5 billion passengers without suffering a single fatality due to a train accident. The image of the Shinkansen train speeding on the plain below a snow-covered Mt. Fujiyama has become an icon of modern Japan.

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<sup>1</sup> There is no agreed definition of “high-speed” rail. The original Japanese Shinkansen trains operated at 210 Km/hr (130 Mph) and the British HST operates at 125 Mph. Currently, train services faster than about 250 Km/hr (155 Mph) establish the boundary of “high-speed”, though some trains in China have operated at 350 Km/hr (217 Mph). Experimental runs have reached 575 Km/hr in France. The high-speed parts of the planned CA HSR system are required to be designed for 220 Mph, though operation between San Francisco and San Jose will be limited to 177 Km/hr (110 Mph).

<sup>2</sup> See, e.g., [https://en.wikipedia.org/wiki/UAC\\_TurboTrain](https://en.wikipedia.org/wiki/UAC_TurboTrain) accessed March 8, 2019

Table 2 shows the traffic levels on the world's high-speed lines. Since the completion of the build-out of the Shinkansen system in the early 1990s, traffic growth has been slow.

Not so well known is that the old Japanese National Railway collapsed under a mountain (\$250 billion) of debt (only partly arising from Shinkansen construction) and operating losses. In 1987, the Government drastically restructured the system, creating six passenger companies, one freight company, one company that owned the high-speed infrastructure, and a "settlements" company into which much of the pre-existing debt and the non-rail assets were moved. Subsequently, four of the passenger companies have been profitable and were privatized. The high-speed infrastructure was sold to the four larger passenger companies at a price that earnings could support. Two of the passenger companies remain unprofitable and in government hands. The freight company slowly became marginally profitable and has been privatized. Taxpayers eventually had to absorb around \$200 billion after all debt and assets were finally settled or sold.<sup>3</sup>

**France.** The French TGV (Train à Grande Vitesse) began in 1981 because the existing capacity of the Paris to Lyon line was saturated. A new line was built to carry much higher speed trains (originally 250 Km/hr, now up to 320 Km/hr on some lines). The system has been extended to cover most of France's major cities. Some services extend into Germany and Switzerland because the TGV trainsets are capable of operating on conventional lines as well as the exclusive high-speed lines. The ability to operate over both high-speed dedicated lines and conventional lines where new construction would be prohibitively costly was one of the important innovations of the TGV approach.

TGV services have always been financially and operationally integrated into the French national railway (SNCF) so it is not clear which of the TGV services cover their operating and capital costs. Studies (French law mandates retrospective economic studies of projects over a certain size) have found that the original TGV line from Paris to Lyon is fully profitable, including coverage of investment, and that a number of the other lines generate economic benefits in excess of their costs including investment, but these cannot be verified from public sources.<sup>4</sup> What is clear is that the SNCF overall generates large losses and is a major financial burden to the Government. There have been a number of attempts to restructure the system that failed due to political resistance, especially from the SNCF labor unions and SNCF continues to generate large losses.

TGV traffic (Table 2) grew rapidly at the outset but, as in Japan, has been essentially stable since completion of the system. In fact, TGV traffic actually shrank over the past ten years. The TGVs have carried 2.4 billion passengers without a passenger fatality due to an operating crash.

**Germany.** Deutsche Bahn (DB) took a more evolutionary approach to high-speed rail. Though pieces of new, high-speed lines have been built, the system was developed based on a mixture of high-speed lines along with up-graded medium speed and conventional lines. The rolling stock (Intercity Express, or ICE) can operate system-wide, with some ICE trains operating from

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<sup>3</sup> Japan Times editorial, "Privatization of JNR, 39 years on," April 24, 2017.

<sup>4</sup> See, e.g., Chapulut and Taroux 2010

Germany into Switzerland, Austria, Belgium and the Netherlands. ICE trains began operating in 1991 and have carried about 1.5 billion passengers (Table 2) since then. There has been one crash involving 101 fatalities in 1998.<sup>5</sup>

Despite the growth of ICE traffic, DB as a corporation has had a troubled financial history, especially since the reunification of Germany in 1991. DB now has debts of more than €20 billion and a recent Court of Auditors report called for a searching review of DB's organization and objectives.<sup>6</sup>

**China.** Compared with Japan, France and Germany, the experience in China can only be called astounding. After starting construction in 2005, China Railways has built an HSR system of 21,635 Km, nearly 2.8 times that of Japan, France and Germany combined and essentially equal to all of the other high-speed lines in the world. After only 10 years of development, high-speed traffic on China Railways is 2.6 times that of Japan, France and Germany combined – and it is still growing rapidly. (Figure 1). More remarkable is the fact that, while the E.U. and Japanese systems are essentially complete, China Railways intends to add another 9000 Km of high-speed line by the end of 2020 and an additional 8000 Km by the end of 2025 (for a total of 38,000 Km). At current ridership densities, this indicates that in 2025 China Railways could see more than three billion high-speed passengers annually – about 8 times that of Japan and 15 times that of France and Germany combined.

China had a number of objectives in initiating its HSR program in addition to improving passenger service, *per se*. Probably most important, the entire Chinese network was saturated, with a total traffic density (passenger-Km plus freight tonne-km per line Km) that was more than three times the U.S. and almost 15 times that of the western E.U. rail networks. One perhaps counterintuitive objective for building new high-speed passenger lines was to get rail passenger traffic out of the way of vitally needed freight on the conventional lines, especially because the Chinese highway network is still not fully developed: rail plays a larger role in China than in the U.S. and a much larger role than in the E.U. Another objective was to create much stronger economic linkages between the more developed Eastern and coastal regions and the underdeveloped regions in Western China. The central government also used the HSR construction program for economic stimulus, especially in the less developed areas.<sup>7</sup>

The financial and economic performance of the program offers good and bad news. Although reliable data are always difficult to obtain in China (especially for the railway because rail traffic has national security implications), World Bank studies indicate that some of the more densely used high-speed lines have covered their costs, including debt service, and have generated financial rates of return between 6% and 9% for the more profitable 350 Km/hr lines and less than 1% for the 250 Km/hr lines.<sup>8</sup> The difference is partly due to higher demand on the higher-speed lines and more significantly due to political and regulatory suppression of prices on the lower speed lines.

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<sup>5</sup> See [https://en.wikipedia.org/wiki/Eschede\\_derailment](https://en.wikipedia.org/wiki/Eschede_derailment)

<sup>6</sup> Briginshaw, 2019

<sup>7</sup> Financial "Leakage" may also have been an objective: the former Rail Minister is now in jail for accepting bribes arising from the massive construction program.

<sup>8</sup> Lawrence, et al, 2018

Even though some of the better performing lines are profitable, the overall picture is not nearly as bright. The investment cost of the system has been in the range of \$500 billion so far and it will obviously increase as more lines are built. The system has been built by “Joint Ventures” between China Railways and local governments, with each contributing half. Although the source of the finance was supposed to be half debt and half “equity”, it is likely that most of the equity was actually borrowed from a state controlled bank. Since much of the debt cannot be repaid from earnings of the system, it will inevitably need to be repaid or refinanced by the national and local governments, and some observers believe that the local governments will simply be unable to repay their debts.<sup>9</sup>

Since most of China’s corporations are state owned, China’s debt to GDP ratio including state enterprises has been estimated at 282 percent, making China the second most indebted country in the world.<sup>10</sup> Debts associated with the HSR program have undoubtedly been a significant contributor to this dilemma. Ansar, et al, also conclude that Chinese rail projects (not all of them HSR) have had an average budget overrun of over 40 percent and have tended to take longer than scheduled though, to be fair, Chinese rail construction schedules tend to be about 1/3 faster than in the E.U. and the U.S.

**Amtrak.** Amtrak’s higher-speed passenger services in the Northeast Corridor (NEC) from Washington, DC to Boston, MA via New York City are much smaller than Japan, France, Germany and China. There are two types of service. “Acela” operates European style rolling stock, offers Business and First Class service only, and operates at speeds of up to 250 Km/hr over short portions of the 731 Km distance. “Regional” trains operate with electric locomotives hauling conventional coaches and operate at speeds of up to 210 Km/hr over much of the distance. There are no Amtrak services outside the NEC that travel faster than 170 Km/hr, and most of Amtrak’s services are much slower.

Amtrak reports show that the Acela and Regional trains earn a large surplus over their direct operating costs while essentially all of the conventional services fail to cover even their operating costs from passenger revenues.<sup>11</sup> Amtrak does not report NEC infrastructure costs separately, so it is not clear whether the NEC trains cover their full costs and actually make a “profit.” What is clear is that Amtrak overall is unprofitable, costing taxpayers \$50.2 billion (\$80.7 billion in 2017 \$) since its inception in 1971.<sup>12</sup>

The foreign experience supports at least a few overall conclusions about HSR services. HSR is a fully proven operational and technological fact. It has been built in a number of countries and has carried many billions of passengers in comfort and safety. Though the HSR services are often provided by loss-making national railway entities, continuing public support suggests that there is a consensus that the HSR services have been worth the effort: political pressures are usually to expand HSR service, never to reduce it. From this perspective, the issue in California is simply a

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<sup>9</sup> See, e.g., Xiang, 2018

<sup>10</sup> Ansar, 2016, p 385

<sup>11</sup> See Amtrak Monthly Performance Report for 2018 at <https://www.amtrak.com/about-amtrak/reports-documents.html>

<sup>12</sup> Unpublished history of Amtrak appropriations furnished to the author by Federal Railroad Administration

matter of political will. Does the California polity attach the same values and costs to HSR that pertain in other countries?

## COMPARING THE INSTITUTIONS

Each of the existing HSR service providers exists within its own institutional and ownership framework. The institutional framework is important because it influences how the participants measure and value benefits and costs. Table 3 summarizes the determining characteristics of the institutional structure of the major high-speed railways in the world.

Ownership of the **infrastructure** (track, electrification and signals) ranges from a fully private corporation (Japanese Shinkansens) through Public-Private Partnerships (PPPs) (Taiwan) and public corporations (Amtrak, China Railways and Korean Railways) to publicly owned agencies not in corporate form (most E.U. railways and the CA HSR Authority).

It is the policy of the E.U. Commission that infrastructure agencies should be separated from all **operators** and should allow all qualified operators (conventional passengers and freight as well as HSR) access to the infrastructure on equal terms. Though France and Spain as yet have only single operators for all passenger services (all are publicly owned corporations). Italy, Germany, Belgium, Netherlands, Sweden and UK have open access with competing operators, some public and some privately owned. None of the Asian HSR railways have open access and none allow competition in any service. Amtrak allows multiple access for non-competing services (commuter and freight) on its NEC lines (and charges them an access fee) but does not allow competing HSR or conventional operators.

The CA HSR Authority expects to award an exclusive non-competitive HSR concession, but the concessionaire will have to operate jointly with Caltrain and Metrolink in the commuter areas. By not allowing competition in the HSR services, the CA HSR Authority would be required to oversee and regulate the quality, frequency and prices of the services offered in order to strike whatever balance is targeted between financial and economic benefits. This is an issue that the Authority and the legislature have yet to consider fully. In addition, in the joint operating areas, the multiple operators would have to confront a complex series of access priority and pricing that has never been fully resolved in the E.U.

## WHAT ABOUT CALIFORNIA HIGH-SPEED RAIL?

No two railways are the same, and that holds when comparing the CA HSR proposal with other HSR systems. Every generalization has a *caveat* and that is nowhere more true than with HSR systems. With that said, there do appear to be a number of ways in which other systems have survived or flourished while the California system has floundered.

**Stable and unified government leadership.** The most important single factor in HSR success elsewhere has been that HSR systems have enjoyed the committed support and leadership of a unified government. The railway has been owned and led by the national government where HSR policy is developed and consistently followed. For example, in China, the World Bank concluded:

“Careful planning, consistently implemented, is required to deliver a large infrastructure program. In China, development of a well-analyzed Long-Term Plan provided a clear and consistent framework for action. Government provided strong support for the plan, especially (sic) and changes to the plan were minimal. This provided a strong framework upon which all parties could depend and focus on delivery.”<sup>13</sup>

Although China has an unusual degree of central control, all of the other HSR systems (including Amtrak)<sup>14</sup> were instruments of national policy and not subject to conflicts between national and local government levels or within local authorities.

The CA HSR project could hardly be more different. It originated in a referendum that directly overrode control by the legislature, thus denying the project legislative agreement and commitment.<sup>15</sup> The sources of funding were federal American Recovery and Reinvestment Act of 2009 (ARRA) money along with key roles by FRA and FTA. State funding came from Prop 1A bonds, but had to be matched by other (undefined at the time) sources. Funding from Cap and Trade receipts was highly contentious and unstable year-to-year. Private money was promised but eventually proved unavailable, at least until after the project is in operation.

Unfortunately, also, California is an object lesson in the problems of project planning and management in the face of political fragmentation. California has now had three Governors since passage of Prop 1A, and each has had different appointees and priorities. The California state government has far less control over the actions of its local jurisdictions than do the national governments with HSR systems, so fully accepted decisions are hard to reach and even harder to implement. The net result was oversight conflict that sometimes verged on chaos, making project planning and management very difficult.

**Reliable and adequate funding.** Multi-year mega-projects must be able to develop multi-year construction plans that do not have to be revised from one year to the next, and they must be able to package the work into efficient contract sizes. This can only be done when project financing is predictable, stable and adequate. Other HSR systems had suitable financing because of the size of their governments and the commitments the governments made to their railway projects. By contrast, the CA HSR program has always never been fully funded and has never had a credible financing program for completing the project. Effective management under these circumstances is simply not possible.

**Managerial capability.** All of the HSR systems were planned, constructed and operated by an existing railway fully staffed with competent engineers and managers that were able to see the project through. The World Bank said of the Chinese projects:

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<sup>13</sup> Lawrence 2018, pg 65. This finding was connected to a review of the Chinese HSR program, but it clearly applies to all infrastructure programs.

<sup>14</sup> The NEC does include eight states and the District of Columbia, and it has a number of operators, but the fundamental leadership comes (when it does) from the U.S. Department of Transportation.

<sup>15</sup> The use of the proposition process was also unfortunate because the voters were presented with a “vision” that had not been subjected to the normal process of critical review, either in the state government or the legislature. As a result, when the project began to encounter problems, it became an orphan.

“Aspects of the project management system that contribute to this include: project management structure with clear responsibilities and delegation of authority, [and] managers that stay for the entire duration of the project...”<sup>16</sup>

By contrast, the CA HSR project had no existing institutional depth or background. It was almost totally staffed by consultants at the beginning and still relies more heavily on outside consultants than most HSR systems. Consultants bring expertise, of course, and they are subject to professional standards: at the same time, they should be led by a full complement of state employees who can speak for the state in planning and policy issues. This was certainly not the case in the early years of the project and continues to cause problems with contract oversight.<sup>17</sup> Overall, it is clear that a large part of the project’s oversight problems have been caused by an inexperienced and undersized in-house staff that was unable to oversee a large number of outside consulting teams. This has improved somewhat over time, but it was missing in the all-important planning stages of the project and is still a problem.

**Valid planning objectives.** As discussed above, very few individual HSR lines<sup>18</sup> (and **none** of the HSR systems) are financially profitable if “profitable” means that revenues from customers must cover all costs including a return on investment. All of these systems were planned and are operated with a clear and explicit understanding that they serve both a market (commercial) and a public purpose: the customer pays for the market values (trip time, comfort, cost) and the public supports the public benefits (reduced emissions of pollution and CO<sub>2</sub>, improved safety, regional and urban development, reduced noise, employment access). This is why many evaluations have concluded that the economic viability of HSR projects is often stronger than their financial viability and is why governments are willing to support them.

Unfortunately, the CA HSR project had to be planned and justified based on manifestly unrealistic promises because it was not possible for the promoters to be explicit (honest) about the eventual required role of public financing (unless it was “free” federal financing or private investment). As a result, the law contains a requirement that the system not be “subsidized” without defining the term. This caused two problems. First, if subsidy means revenues covering purely operating costs (energy, wages and maintenance) the odds of not needing a “subsidy” are good; but, if it means, for example, covering a portion of debt and repaying investment, then no system, including CA HSR, can meet the requirement. Without an explicit understanding of, and agreement on, the terminology, at least some part of the public political support will be lost when the performance of the system emerges and the opportunity for litigation over the issue of state support will be increased. Second, there is a direct tradeoff between financial viability and economic viability in the fare structure. When fares are driven upward by a need to cover financial “costs,” the ability of the system to generate public benefits by, for example, shifting traffic from road and air to rail is reduced accordingly. Other HSR systems were (to various degrees) planned with public benefits in mind and the fare systems are reviewed with both the financial and the economic performance of the systems in mind.

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<sup>16</sup> Lawrence 2018, p 65

<sup>17</sup> “Moreover, the Authority has in essence placed portions of its oversight of large contracts into the hands of outside consultants, for whom the State’s best interests may not be the highest priority. In addition, CMSU [Contract Management Support Unit] - which is staffed by consultants rather than Authority employees - has performed only weak and inconsistent oversight.” Auditor’s report 2018, pp 2,3.

<sup>18</sup> Possible exceptions are Tokyo to Osaka and Paris to Lyon.

California HSR (indeed rail passenger systems in the U.S. in general) had to be planned and justified without being able to admit that much of the public investment would never be recovered from system revenues. At one level, this meant that the promoters had to promise (or hope for) a greater level of federal (“free,” to the state, at least) support and private involvement than any existing federal or state programs could provide. In addition, it meant that the planning and start-up of the project were warped by a determined rush to claim the federal ARRA money even though, as the state auditor ultimately found, the rush eventually led to serious mistakes and extra costs.<sup>19</sup> The rush forced the Authority to accede to a federal requirement to commit to beginning in the Central Valley rather than in the Peninsula and the Los Angeles area with the result that the section will have far less utility than if the work had begun on the ends. Most important, the rush forced work to commence before a sufficient financing program was developed and agreed. All of these issues were laid out as early as a Legislative Analyst’s Office (LAO) report dated May 10, 2011 and a letter from the PRG to the legislature dated July 1, 2011.<sup>20</sup>

**Protracted litigation.** Foreign high-speed systems are usually planned centrally. The government and/or the railway then hold discussions on the plans with local authorities, reach compromises when they can, and then the systems get built. In China, there is no (safe) way to protest the right-of-way acquisition. Since local authorities are often partners in the later HSR lines, there is little or no local opposition – and the lines gets built. Japan and the E.U. countries are less authoritarian than China, of course, but the relative balance of power between national and regional/local means that national objectives tend to be implemented. Local interests are usually considered in the process of developing plans, but projects, once started, are not usually delayed by local political opposition. Opportunities for delay through litigation are severely constrained.

In the U.S., increasingly, and especially in California because of the added burden of the California Environmental Quality Act (CEQA), a decision to implement a program is only the beginning. Projects such as HSR then must navigate a thicket of planning and environmental steps, any one of which can cause significant delay. The U.S. legal process gives local entities and private individuals an unusual ability to delay or even bring a project to a halt on arguments about limited “damages” or even on purely procedural grounds. Almost anyone can delay or stop a project, essentially no one can make it move ahead.

This is not a hypothetical concern. A \$70 billion project delayed for a year during 2 percent inflation adds \$1.4 billion to the cost of the project -- far more than legal costs or likely damages. The concerns are often valid and real, and they clearly deserve a day in court. Unfortunately, courts move far too slowly considering the costs that delay adds. Other countries do a far better job of resolving this problem than the U.S. and California.

## SUMMARY

Overall, in the light of the challenges faced by the HSR Authority by comparison with other HSR systems, it is not surprising that the project has been unstable, over budget and well behind

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<sup>19</sup> See Auditor’s Report, pg. 2 and pg 17.

<sup>20</sup> See PRG website at [www.cahsrprg.com/documents](http://www.cahsrprg.com/documents) for listing of all PRG letters and reports.



schedule. This leaves two questions: 1) could these problems have been foreseen and alleviated at the beginning of the project?; and 2) given the current state of the project, is there any prospect that they can be fixed now?

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Table 1  
**Profile of Higher Speed Railways**

Country	Km of Higher Speed Line			2017 HSR Passengers (000)	2017 HSR Passenger-Km (000,000)	Average Trip Length (Km)
	> 250 Km/hr	160 to 250 Km/hr	Total			
<b>Japan (4 JRs)</b>	2,849		2,849	377,441	101,247	268
<b>China</b>	10,480	11,155	21,635	1,517,800	577,635	381
<b>Taiwan (THSRC)</b>	350		350	60,570	11,103	183
<b>Korea (KTX)</b>	149		657	59,669	14,869	249
<b>France (RFF/SNCF)</b>						
	2,166		2,166	108,721	58,280	536
<b>Germany (DB)</b>	1,104	1,511	2,615	86,732	28,502	329
<b>Italy (FS)</b>	909	1,718	2,049	23,882	5,513	231
<b>Spain (ADIF/RENFE)</b>	2,482	713	1,255	22,955	6,514	284
<b>Sweden*</b>	-	na	na	9,918	3,604	363
<b>Belgium (SNCB)</b>	108		108	6,400	1,500	234
<b>Netherlands</b>		120	120	4,098	413	101
<b>UK**</b>		10,869	10,869	10,300	4,825	468
<b>U.S. (Acela)</b>						
		596	596	3,442	1,048	305
<b>U.S. (NEC Regional)</b>		596	596	8,570	2,142	250
<b>CAHSRA (Phase I)</b>	741	97	837	42,000	16,002	381

21,338

46,702

Sources: UIC, International Railway Statistics 2017, Table 10 and Table 50

China data from the World Bank.

Amtrak, Monthly Performance Summary, Sept 2018

CAHSRA Business Plans and data furnished by CA HSRA to PRG

\* Sweden data mostly represent X2000 (tilting) trains on 200 Km/hr lines.

\*\* Km for the entire network, Passengers for Eurostar only.

Table 2

HSR Passenger Traffic*																		
	JRs (Shinkansen)			SNCF			DB AG			China Railways			Amtrak NEC					
	Japan			France			Germany			China			Acela/Metroliners			NEC Regional		
	Passengers (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Passengers (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Passengers (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Passengers (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)
1964	11,018	3,912	355															
1965	30,967	10,651	344															
1966	43,784	14,489	331															
1967	55,250	17,991	326															
1968	65,903	21,027	319															
1969	71,574	22,816	319															
1970	84,627	27,890	330															
1971	85,354	26,795	314															
1972	109,854	33,835	308															
1973	128,080	38,990	304															
1974	133,195	40,671	305															
1975	157,218	53,318	339															
1976	143,000	48,149	337															
1977	127,000	42,187	332															
1978	124,000	41,074	331															
1979	124,000	40,986	331															
1980	126,000	41,790	332															
1981	126,000	41,717	331	1,260	700	556												
1982	143,000	46,105	322	6,080	3,600	592												
1983	161,000	50,440	313	9,200	5,700	620												
1984	164,000	50,826	310	13,770	8,300	603												
1985	180,000	55,423	308	15,380	9,300	605												
1986	183,012	55,943	306	15,370	9,400	612												
1987	206,822	57,414	278	16,970	10,400	613												
1988	227,759	64,351	283	18,100	11,200	619												
1989	236,536	65,965	279	19,160	12,200	637												
1990	260,057	72,173	278	29,930	14,900	498												
1991	275,104	74,221	270	37,000	17,900	484	5,100	2,000	392									
1992	276,531	73,061	264	39,300	19,000	483	10,200	5,200	510									
1993	275,855	72,563	263	40,120	18,900	471	14,600	7,000	479									
1994	262,985	68,248	260	43,910	20,500	467	21,300	8,200	385			2,024	na	na	5,509	na	na	
1995	275,900	70,827	257	46,590	21,430	460	27,259	8,700	319			2,001	na	na	5,872	na	na	
1996	280,964	72,948	260	55,915	24,787	443	27,363	8,850	323			2,011	na	na	5,665	na	na	
1997	282,815	73,214	259	62,881	27,583	439	30,947	10,073	325			2,081	na	na	5,548	na	na	
1998	280,457	71,019	253	70,575	30,619	434	31,201	10,155	325			2,135	496	232	5,786	1,516	262	
1999	277,437	70,034	252	74,258	32,192	434	35,642	11,591	325			2,241	522	233	5,903	1,522	262	
2000	280,607	71,154	254	79,685	34,747	436	41,610	13,925	335			2,408	570	237	6,113	1,527	250	
2001	282,492	72,316	256	83,481	37,404	448	46,668	15,515	332			2,652	666	251	6,020	1,625	270	
2002	278,365	71,537	257	87,860	39,856	454	47,636	15,255	320			3,214	912	284	5,760	1,537	267	
2003	282,559	73,000	258	86,742	39,604	457	56,480	17,457	309			2,937	819	279	5,975	1,554	260	
2004	290,045	74,669	257	90,890	41,439	456	63,705	19,604	308			2,967	831	280	6,405	1,601	250	
2005	301,336	77,903	259	94,020	43,130	459	66,819	20,853	312			2,453	679	277	7,116	1,677	236	
2006	305,046	79,439	260	97,862	44,853	458	69,533	21,635	311			2,668	759	284	6,755	1,623	240	
2007	315,778	82,823	262	105,366	47,966	455	70,531	21,919	311			3,191	929	291	6,837	1,655	242	
2008	310,237	81,658	263	116,054	52,564	453	74,700	23,333	312	7,000	1,600	229	3,399	1,016	299	7,489	1,844	246
2009	288,836	76,309	264	114,395	51,864	453	73,709	22,561	306	47,000	16,200	345	3,020	919	304	6,921	1,702	246
2010	292,037	77,426	265	112,558	51,890	461	78,507	23,903	304	133,000	46,300	348	3,219	923	287	7,149	1,704	238
2011	297,125	79,532	268	111,533	52,044	467	76,100	23,306	306	286,000	105,800	370	3,379	1,047	310	7,515	1,879	250
2012	321,419	86,001	268	110,825	51,086	461	76,600	24,753	323	388,000	144,600	373	3,395	1,040	306	8,014	2,005	250
2013	333,474	89,177	267	109,796	50,786	463	78,770	25,178	320	530,000	214,100	404	3,343	1,018	304	8,044	1,982	246
2014	339,760	90,280	268	108,978	50,659	465	77,951	24,316	312	870,000	282,500	325	3,545	1,081	305	8,083	2,018	250
2015	350,465	94,313	269	103,230	49,980	484	79,451	25,280	318	1,137,000	386,300	340	3,474	1,058	305	8,215	2,074	252
2016	285,755	78,243	274	104,189	49,104	471	83,422	27,213	326	1,444,000	464,100	321	3,489	1,058	303	8,409	2,122	252
2017	377,441	101,247	268	108,721	58,280	536	86,732	28,502	329	1,713,000	660,000	385	3,442	1,048	305	8,570	2,142	250
	11,529,835			2,441,954			1,452,536			6,555,000								

\* High-speed as defined by the railway. For DB this would include some traffic <250 Km/hr

Source: UIC, International Railway Statistics 2017, Table 10 and Table 50. Data for China furnished by World Bank

Table 3

**Organization and Ownership of Higher Speed Railways**

Country	Ownership of Infrastructure	Multiple HSR Access?	Multiple Access by Non-HSR Operators	Private Operators for HSR?	Access Regime
Japan (4 JRs)	Private Corp	No	No	Yes	Closed
China	Public Corp	No	No	No	Closed
Taiwan (THSRC)	PPP	No	No	PPP	Closed
Korea (KTX)	Public Corp	No	No	No	Closed
France (RFF/SNCF)	Public Agency	No	Yes	No	"Open"
Germany (DB)	Public Agency	Yes	Yes	Yes	Open
Italy (FS)	Public Agency	Yes	Yes	Yes	Open
Spain (ADIF/RENFE)	Public Agency	No	Yes	No	"Open"
Sweden*	Public Agency	No	Yes	Not Yet	Open
Belgium (SNCB)	Public Agency	Yes	Yes	Yes	Open
Netherlands	Public Agency	Yes	Yes	Yes	Open
UK	Public Agency	Yes	Yes	Yes	Open
U.S. (Acela)	Public Corp	No	Yes	No	Limited
U.S. (NEC Regional)	Public Corp	No	Yes	No	Open
CAHSRA (Phase I)**	Public Agency	No?	Yes	Yes	Limited

Source: Author's research

Figure 1

# Passengers Carried (000)

