Utah FOUNDATION Research Report

Report Number 694, August 2010

HIGH-SPEED RAIL AROUND THE WORLD:
A SURVEY AND COMPARISON OF EXISTING SYSTEMS

HIGHLIGHTS

- Most countries with high-speed rail systems are economically well-developed, owing to the significant capital investments such systems require.
- Most countries with high-speed rail systems are geographically small and densely populated. This is likely because high-speed rail works best when connecting major population centers less than 600 miles apart.
- Most countries with high-speed rail systems have governments that are relatively centralized compared to the United States. This could be due to the fact that implementing high-speed rail requires the coordination of finance, policy, and regulation across regional and local governments, as well as unified national policy directives.
- The federal system of government in the United States would likely require one of two arrangements to implement high-speed rail across the country, due to the prohibitive expenses for most states to finance high-speed rail on their own: 1) a federally funded, owned, and operated high-speed rail network, or 2) regional coalitions of state governments or regional agencies that collectively fund, own, and operate high-speed rail on a regional basis, possibly, and perhaps requisitely, with some federal funding.

The mission of Utah Foundation is to promote a thriving economy, a well-prepared workforce, and a high quality of life for Utahns by performing thorough, well-supported research that helps policymakers, business and community leaders, and citizens better understand complex issues and providing practical, well-reasoned recommendations for policy change.

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Over the past 10 years, high-speed rail has emerged as a mode of transportation that is increasingly important and integral to national and international transportation systems. While many countries, most notably China, have recently invested significant resources in building comprehensive high-speed rail networks, the United States has been somewhat less involved—up until now. With President Obama's recently announced program to fund select high-speed rail initiatives across the country, it seems timely to ask what role high-speed rail will, or will not, play in the future of American transportation.

In 2010, the Western High-Speed Rail Alliance (WHSRA) contracted with the Utah Foundation to undertake a background study of high-speed rail (HSR) systems worldwide to assist WHSRA as it begins to assess the feasibility of implementing a high-speed rail system in the Rocky Mountain region of the United States. The WHSRA comprises the Metropolitan Planning Organizations (MPOs) of four states, including the Denver Regional Council of Government (Denver, Colorado), the Maricopa Association of Governments (Phoenix, Arizona), the Regional Transportation Commission of Southern Nevada (Las Vegas, Nevada), the Regional Transportation Commission of Washoe Country (Reno, Nevada), and the Utah Transit Authority (Salt Lake City, Utah).[1]

DEFINITIONS

High-speed rail (sometimes referred to as "bullet trains") is, broadly defined, rail transportation that is significantly faster than regular rail. Most new rail projects are considered "high-speed" if they reach speeds of at least 250 km/h (155 mph). Doing so requires either upgrades to existing rail or, in order to reach speeds over 250 km/h, entirely new tracks.[2] In discussing high-speed rail, it is useful to define some basic terms:

High-speed rail (HSR) – for the purposes of this report, rail projects where trains regularly operate at or above 250 km/h.

Train set – a set of train cars, including the engine, which operate together as a train.

Rolling stock – the stock of trains owned by a company.

Figure 1: Kilometers to Miles Conversion Reference

Kilometers	Miles
1	0.62
100	62
200	124
250	155
300	186
1000	620

Rail gauge – the width between the two rails of a track; different trains require different widths of track to operate on.

Standard gauge – the width of the most commonly used rail gauge worldwide; all track in the United States is standard gauge.

Operations – the managing, running and maintaining of trains and train services.

Infrastructure – the actual track and physical structures associated with rail.

Since the most commonly used measure of speed and distance, when speaking of rail transport internationally, is kilometers (km), above is a guide for converting kilometers into miles, along with several commonly used speeds and distances from the report.

OBJECTIVES AND METHODOLOGY

In response to the WHSRA's request for information on existing HSR systems worldwide, Utah Foundation has prepared a report covering the following objectives:

1. Identify countries where HSR is currently in operation.
2. Describe:
    a. The political, economic and other conditions within the country relevant to the HSR system.
    b. The features of the HSR system itself, including the type and location of the system, how it is governed and managed, how it is financed, etc.
3. Draw preliminary conclusions regarding common conditions and features observed in the countries surveyed.

In order to address each of these objectives, the following methodology was used. To identify which countries currently employ HSR systems, as well as to identify what qualifies as HSR, the classifications used by the International Union of Railways (UIC) were used. While these differ in some cases from those definition used by the Federal Railroad Administration (FRA), the UIC classifications represent a more international consensus on HSR definitions, which seemed appropriate, considering that this report will make an international survey and comparison of HSR systems. Due to the very limited use, limited economic feasibility, of high-speed *freight* rail, this report will confine itself to examining *passenger* high-speed rail.

According to UIC, HSR is defined in two ways. The first definition is more broad and covers existing systems where trains regularly operate at or above 200 km/h (125 mph). The second, and more narrow, definition covers *new* systems where trains regularly operate at or above 250 km/h (155 mph).[3] The second definition is the one used by UIC in monitoring new and future HSR projects and is typically the definition applied in international settings. Because this report will be used to inform the potential for new and future HSR systems in the United States, the latter definition will be used. Under the 250 km/h definition, 14 countries currently have HSR systems, including the United States. While the only HSR train in the United States, the Acela, which runs from Washington DC to Boston, technically only reaches a maximum speed of 241 km/h, UIC nonetheless classifies it as HSR.

In order to describe the political, economic and other conditions in countries with HSR systems, this report will examine two types of data. The first will be aggregate, quantitative data, or numeric data which is available for all HSR countries, and in some cases, for the European Union (EU) as a whole. These data include, among other things, measures of Gross Domestic Product (GDP), country population, land mass, etc. These will be displayed in charts and used to compare countries' transportation infrastructure, including the size of HSR systems, as well as political, economic, geographic, demographic and even cultural factors that are of relevance to HSR.

The second type of data will be more descriptive qualitative and anecdotal data. Much of this data is incidental, or only available for some countries and not others. It includes descriptions of countries' geographic features and political systems, as well as descriptions of who owns and operates rail transport and how it is managed and financed. This data will be displayed by country.

After having examined the features and conditions of HSR systems and the countries in which they exist, preliminary conclusions will be drawn, based on features that seem common to most countries with HSR. These conclusions will only be preliminary, however. A more systematic method of comparison would be needed to reach firmer conclusions.

Finally, some factors should be taken into consideration when evaluating and comparing the data and information in this report. First, comparisons between countries, even using similar quantitative data, need to be done carefully for several reasons. First, data collections methods and reliability are not necessarily uniform between countries. Second, the data gathered, especially for large and populous countries, will not necessarily reflect differences *within* the countries, such as between regions; for instance, differences between the western and eastern United States. Countries are usually much more complex than country-level data can suggest.

REVIEW OF EXISTING SYSTEMS AND COUNTRY CONDITIONS

High-Speed Rail Systems

Figure 2 shows the current status of HSR infrastructure by country. "Lines in Operation" is the length of HSR routes currently operating. "Lines under Construction" and "Lines Planned" are the length of HSR routes currently being built or planned. The "Fastest Scheduled Trains" shows what the maximum speed is of regularly scheduled trains. The average speed of the fastest trains in a country are also listed, as are the fastest speeds of test trains that have been run in the country.

China, by far, has the largest existing HSR network, followed by Japan, France, Spain and Germany. China also has the most ambitious expansion plans, with the most kilometers of lines currently under construction and the most planned. Spain is also undergoing an HSR construction and planning boom, with France and Turkey

Figure 2: High-Speed Rail Infrastructure by Country

Country	Lines in Operation (km)	Lines under Construction (km)	Lines Planned (km)	Total Lines (km)	Fastest Scheduled Train(s) (km/h)	Avg. Speed of Fastest Scheduled Train (km/h)	Test Run Speed Record (km/h)
Belgium	209	0	0	209	300	237	347
China	3,529	6,696	2,901	13,126	431 (mag.); 350	313	502 (mag.); 394 (conv.)
France	1,872	234	2,616	4,722	320	272	574
Germany	1,285	378	670	2,333	300	226	550 (mag.); 406 (conv.)
Italy	923	0	395	1,318	300	178	368
Japan	2,452	590	583	3,625	300	256	581 (mag.); 443 (conv.)
Netherlands	120	0	0	120	300	<140	336
South Korea	330	82	0	412	300	200	355
Spain	1,604	2,219	1,702	5,525	300	236	404
Switzerland	35	72	0	107	250	<140	280
Taiwan	345	0	0	345	300	245	315
Turkey	235	510	1,679	2,424	250	<140	303
U.K	113	0	0	113	300	219	335
U.S.	362	0	900	1,262	240	161	296 (jet); 264 (conv.)

Source: International Union of Railways (UIC): High Speed Lines in the World. Accessed at: http://uic.asso.fr/spip.php?article573
High Speed Rail by Country. Accessed at: http://en.wikipedia.org/wiki/High-speed_rail_by_country

also notably having ambitious HSR expansion plans. It should be noted, however, particularly in the case of Spain, that European debt troubles could imperil the ongoing construction, as well as future plans for constructing new HSR lines. If it is assumed that expansion proceeds as planned, though, in the next few decades, China will have the largest HSR network, with Spain and France in a distant second and third, both surpassing Japan in total system size.

Concerning HSR speed, China has the fastest scheduled trains, which, along with trains in France, are the only scheduled HSR trains currently operating above 300 km/h. Most HSR countries have trains operating at maximum speeds of 300 km/h, with the United States and a couple of other countries being exceptions to this rule. This could be, in part, because trains reaching 300 km/h require dedicated HSR track. The United States also joins a handful of HSR countries whose fastest trains run at average speeds of less than 200 km/h and who have not tested trains at speeds higher than 300 km/h.

While China is the only country to operate a "magnetic levitation" (maglev) train on a commercial basis, with speeds reaching 431 km/h, Germany and Japan have tested maglev trains at speeds of 550 km/h and 581 km/h, respectively. France has the fastest tested time for a non-maglev, steel-wheeled train, at 574 km/h.

Overall, Japan has the most developed and integrated HSR system, being the first country to develop the technology and make it commercially available in 1964. Europe also has an extensive and well-integrated HSR system. China, while being a newcomer to HSR, has very rapidly expanded its HSR system and has some of the most ambitious plans, by far, of any country for HSR expansion within the country and across the entire Asian continent. In contrast, the United States as a whole has only just recently, with the endorsement and backing of President Obama, begun an effort to develop HSR by allotting funds for the exploration, planning, and in some cases, building of regional HSR systems. Having said this, part of the current efforts to develop HSR includes funding projects, such the one in California, connecting Sacramento to L.A., which have been in the planning phases for some time.

Existing Transportation Infrastructure

Figure 3 shows the existing transportation infrastructure in HSR countries, not including HSR. This infrastructure includes existing airports, railways and roadways, including highways/expressways.

Concerning air travel infrastructure, it is interesting that most HSR countries have a relatively high concentration of airports for their land size. This is particularly true in Europe. This could be indicative of what transportation experts have suggested, that, while HSR is viewed as a competitor to air travel for travel distances under 600 miles, HSR complements air travel infrastructure designed around longer-distance trips. In contrast, the United States and China, which are both geographically much larger than Europe, have significantly fewer airports. This could be a reflection of the fact that population centers are more spread out in these countries than in Europe.

The kilometers of rail in HSR countries is an indicator of the amount of rail-based infrastructure in a country. This is not high-speed rail, but rather rail of any type, for freight or non-high-speed rail passenger trains. Perhaps ironically, the United States, which has very little HSR, has by far the most extensive rail infrastructure of any country in the world, although it comes a close second to the existing rail in all EU countries combined. China has less than a third of the rail infrastructure the United States has, despite its size.

Additionally, Figure 3 shows the kilometers of standard gauge rail in the individual countries. While some HSR requires dedicated track, HSR trains capable of up to 260 km/h can run on existing or modified standard gauge rail (e.g., rail with no at-grade crossings where cars and other traffic intersect with train tracks, instead of going over or under them). Therefore, the amount of standard gauge

Figure 3: Non-HSR Transportation Infrastructure

Country	Land Area (sq km)	Airports*	Airports per 100k sq km	Railways (km)	Standard Gauge (km)	Paved Road (km)	Expressways (km)
Belgium	30,278	14	46.24	3,233	3,233	119,079	1,763
China	9,569,901	195	2.04	77,834	77,084	3,583,715**	53,913
E.U.	4,324,782	456	10.54	229,450	NA	5,454,446**	NA
France	549,970	41	7.45	29,213	29,046	1,027,183**	10,950
Germany	348,672	65	18.64	41,896	41,641	644,480	12,600
Italy	294,140	39	13.26	19,729	18,317	487,700	6,700
Japan	364,485	49	13.44	26,435	3,978	961,366	7,560
Netherlands	33,893	11	32.46	2,896	2,896	136,827**	2,582
South Korea	96,920	25	25.79	3,381	3,381	80,642	3,367
Spain	498,980	30	6.01	15,288	1,392	681,224	13,872
Switzerland	39,997	7	17.50	4888	3397	71,384	1,793
Taiwan	32,260	16	49.60	1,582	345	40,843	976
Turkey	769,632	49	6.37	8,697	8,697	426,951**	1,987
U.K.	241,930	41	16.95	16,454	16,151	398,366	3,520
U.S.	9,161,966	419	4.57	226,427	226,427	4,209,835	75,040

Source: CIA World Factbook.
*Airports listed here are those with runways large enough to accommodate commercial aircraft.
**Total roadways, including unpaved; paved-only totals not available for these countries.

Figure 4: Geographic and Demographic Characteristics of Countries with HSR

Country	Land Area (sq km)	Population	Population Density Per sq km	Urban Population
Belgium	30,278	10,414,336	343.96	97%
China	9,569,901	1,338,612,968	139.88	43%
E.U.	4,324,782	491,582,852	113.67	NA
France	549,970	62,150,775	113.01	77%
Germany	348,672	82,329,758	236.12	74%
Italy	294,140	58,126,212	197.61	68%
Japan	364,485	127,078,679	348.65	66%
Netherlands	33,893	16,715,999	493.20	82%
South Korea	96,920	48,508,972	500.51	81%
Spain	498,980	40,525,002	81.22	77%
Switzerland	39,997	7,604,467	190.13	73%
Taiwan	32,260	22,974,347	712.16	NA
Turkey	769,632	76,805,524	99.80	69%
U.K.	241,930	61,113,205	252.61	90%
U.S.	9,161,966	307,212,123	33.53	82%

Source: CIA World Factbook.

rail in a country can serve as an indicator of rail that can potentially be used for HSR purposes. Here again, the United States is unsurpassed among HSR countries, with all of its existing 226,427 km of rail being standard gauge.

The kilometers of paved roadways and expressways gives an indication of the availability of road-based travel options in a country. The United States has, by a significant margin, the most roadways and freeways of any HSR country and is second only to the EU as a whole. China and France also have notably large roadway infrastructures, with the latter being particularly noteworthy considering its small land area compared to the U.S. and China. Looking over HSR countries generally, it appears that there is little relationship between the amount of paved road infrastructure and HSR. This could be attributable to what research on HSR has suggested, that, while cars are more convenient and accessible in some ways and for some shorter trips, the speed of HSR makes it a more likely choice for trips where the slow speed of cars becomes a significant disadvantage. In this way, as with air travel, roads and HSR can complement each other as transportation alternatives within their respective areas of competitive advantage, cars for shorter trips and trains for longer ones.

Geographic and Demographic Features

Figure 4 gives an overview of the geographic and demographic size of countries with HSR systems, as well as the population density within the countries and the portion of the population that lives in urban areas. The geographic size of a country is an important consideration with regard to HSR because of the potential land area that must be crossed, or served, by HSR.

Population density and urbanization are important considerations in that, in order for HSR to have economies of scale, enough people must be willing to regularly commute or travel from one place to another. In practice, this means HSR works best when connecting large, densely populated cities or population centers. According to most research on the subject, given the current state of technology, HSR works best when connecting population centers less than 600 and more than 100 miles apart. This is because, over 600 miles, airplanes tend to be faster and more efficient and getting their passengers to their destinations; on the other hand, for distances less than 100 miles, cars tend to be quicker because they are more quickly accessible than the stations from which trains depart.

As can be observed from the chart, the large majority of countries with existing HSR systems are less than 550,000 sq. km in size. Only China and the United States are exceptions to this trend, with the latter having very limited HSR systems. Europe, in contrast, has less than half of the land mass of either the U.S. or China.

Although the trend is not quite as strong as with land area, countries with HSR appear to have high population densities, with the large majority having densities over 100 people/sq. km. Compared to most other countries with HSR, the United States has considerably less population density. Having said that, urbanization rates in the U.S. are not significantly different from those in other countries with HSR, implying that U.S. population centers are likely as dense as in other countries, just more spread out.

It is notable that China, which also has large land area, has population centers clustered in certain regions of the country. In China, population is very dense, but most large cities are located in the east of the country and along the east coast. This allows HSR to be focused where it is most efficient and effective within those countries, without having to bridge vast distances between cities. In contrast, the United States has population centers scattered throughout the country and on both coasts. Connecting all the major population centers in the country would therefore probably be expensive and inefficient. Concentrating on HSR within specific corridors and regions would likely prove more workable.

Economic and Political Conditions

Figure 5 displays the type of government within the country and the size of the economy of the country, as measured by Gross Domestic Product (GDP), as well as the GDP per capita, which captures the portion of the economy per person within the country.

GDP is important to consider as a factor in HSR systems because it represents the size of the economy as a whole. The bigger and more advanced an economy is, the more complex transportation infrastructure is necessary, such as air, road and rail transit options, to move people and goods.

Figure 5: Type of Government and Size of Economy in HSR Countries

Country	GDP (PPP*, Billions)	GDP / Capita (PPP*)	Gov Type / Adm
Belgium	$381	$36,600	Fed. Parl./Const. Mon.
China	$8,789	$6,600	Communist State
E.U.	$14,510	$32,600	Intergovernmental
France	$2,110	$32,800	Rep.
Germany	$2,811	$34,100	Fed. Rep.
Italy	$1,760	$30,300	Rep.
Japan	$4,137	$32,600	Parl./Const. Mon.
Netherlands	655	$39,200	Const. Mon.
South Korea	$1,356	$28,000	Rep.
Spain	$1,368	$33,700	Parl. Mon.
Switzerland	317	$41,700	Fed. Rep.
Taiwan	$718	$29,800	Multiparty Democracy
Turkey	$863	$11,200	Rep. Parl.
U.K.	$2,149	$35,200	Const. Mon.
U.S.	$14,260	$46,400	Const. Fed. Rep.

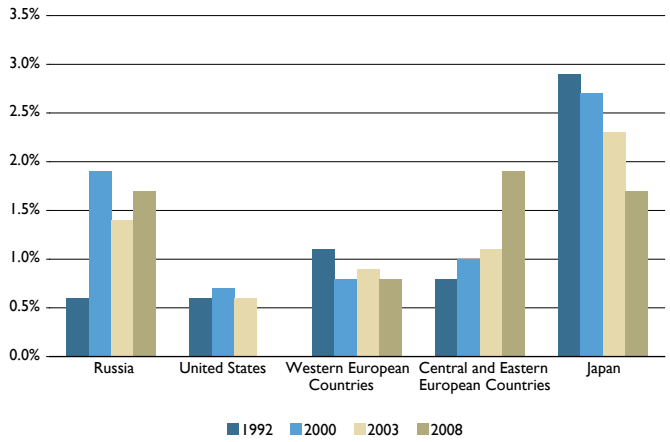
Source: CIA World Factbook.
Abbreviations:
Const. = Constitutional
Fed. = Federal
Mon. = Monarchy
Parl. = Parliament
Rep. = Republic
* PPP = purchasing power parity

GDP also represents an indirect measure of how large a base a national government has to tax and therefore how much government revenue can be raised and resources directed towards HSR. Since HSR development is almost always dependent on government support, GDP is an important measure of the ability of government to marshal resources.

Similar to GDP, per capita GDP is a measure of the wealth of a country. Countries with higher per capita GDPs are more likely to be advanced and have citizens who consume more products and services. Therefore, countries with high per capita GDPs will likely be more amenable to investment in and development of transit options that facilitate their work and lifestyles. Having said this, per capita GDP is an imperfect measure of the wealth of individuals in a country because it is an average and does not represent the dispersion of incomes and income disparities. For instance, some countries have a very high concentration of wealth among relatively few individuals, with the remainder of the population having significantly less income at their disposal; this could yield per capita GDP numbers that do not reflect individual wealth.

Another economic factor of relevance to consider is the proportion of GDP that a country invests in its transportation infrastructure. For an overview of how the United States stacks up compared to other countries, refer to Figure 6. While the countries represented in Figure 6 are OECD countries and do not represent all HSR countries, this nonetheless provides a useful point of reference to where the U.S. stands internationally. Clearly, the United States does not spend nearly what other developed countries do, proportionally, on transportation infrastructure. Having said this, because the United States has a significantly larger GDP overall than most other HSR countries, the total amount spent by the U.S. is, in some cases, as high or higher than these other countries. On the other hand, due to the large U.S. population, coupled with a high per capita GDP, using the percent of GDP as a measure of effort to improve and maintain transportation infrastructure, the U.S. falls behind. This could imply that the U.S. prioritizes investment in transportation behind other national objectives, which could, in turn, be indicative of a potential lack of willingness to invest in projects, such as HSR.

Figure 6: Investment in Inland Transport Infrastructure, OECD Nations, as a Percent of GDP



Source: International Transport Forum. Data reflect current prices and exchange rates. Data for Japan for 2008 refer to 2007. No data is available for the U.S. for 2008.

The type of national government is important to consider with regard to HSR systems for a number of reasons. If a country has a strong, centralized national government, policies, laws and regulations concerning HSR will likely be more consistent and easier to implement and enforce. Federal systems, such as that in the United States are more decentralized, with sub-national governments with significant authorities to regulate and implement policies and local objectives generally.

However, the *nature* of federal systems can vary greatly. The United States is rather unique in having a federal system where the sub-national governments enjoy relatively great autonomy and ability to legislate and enact policy and regulations. Sub-national governments in other countries with federal national governments, by virtue of the size and close proximity of their sub-national governments (and therefore, their greater interdependence) have much less independence.

Another aspect of government type to consider is the relative strength of democratic institutions within the countries in question. While all ostensibly have some form of representative government, China has a very centralized government with significant top-down structures of authority. This stands in contrast to more democratic systems with democratic representation, a variety of political parties and ideologies, and a separation of powers. In such systems, authority is more diffuse and opposing views more influential. Therefore, under such systems, it can be more difficult for political leaders to channel resources and coalesce around common objectives.

Cultural Conditions

One perhaps less obvious condition to consider in relation to countries with HSR systems is the culture of the given country. Culture can play an important role in how people view collective efforts and policies, such as those required to develop HSR systems, as well as how people view, trust, interact and defer to government and others authorities. In this latter sense, culture provides the context within which political conditions and governments exist. In this way, some cultures can be more amenable to certain government policies and collective actions than others.

While it is difficult to generalize culture for countries and to definitively determine whether culture actually has a significant impact on something such as HSR, some commonalities and trends do exist. Business consultant and social psychologist Geert Hofstede has mapped several dimensions of culture that have been used to

Figure 7: Cultural Conditions in HSR Countries As Measured by Hofstede Dimensions

Country	PDI	IDV	UAI	LTO
Belgium	65	75	94	NA
China	80	20	30	118
France	68	71	86	NA
Germany	35	67	65	31
Italy	50	76	75	NA
Japan	54	46	92	80
Netherlands	38	80	53	44
South Korea	60	18	85	75
Spain	57	51	86	NA
Switzerland	34	68	58	NA
Taiwan	58	17	69	87
Turkey	66	37	85	NA
U.K	35	89	35	25
U.S.	40	91	46	29

PDI Power Distance Index
IDV Individualism
UAI Uncertainty Avoidance Index
LTO Long-Term Outlook

Source: Geert Hofstede. Available at: http://www.geert-hofstede.com/hofstede_dimensions.php

assists businesses that have relations with foreign governments and business partners to better understand the cultural environments they operate in. The dimensions listed here include: *Power Distance Index* (PDI), *Individualism* (IDV), *Uncertainty Avoidance Index* (UAI), and *Long-Term Outlook*.

The *Power Distance Index* is basically a measure of deference to authority, or how much distance there is between people of various authority status in a given culture. Countries with a high PDI are ones where individuals defer to and respect authorities in government, business and society. This has bearing on the development of HSR in that countries where there is a high PDI are more likely to defer to decisions by government and other authorities to implement projects, such as HSR.

On the other hand, countries where there is a lower PDI are more likely to have a tradition of not simply accepting decisions by authority and could therefore be more likely to challenge government and other actions that run counter to their interests. Notably, China, which has recently embarked on a massive expansion of HSR, has a high PDI score, where as the United States has a lower one. While there are few clear trends in PDI scores, most countries with well-developed HSR systems have scores above 50.

The *Individualism* score is a measure of the degree to which people in the given culture are individualistically oriented or not. A high IDV score would indicate the presence of a culture of strong individualism, whereas a low score would indicate a culture with strong *collectivist* sensibilities, or cultures that value a sense of unity within communities. Countries with low IDV scores are more likely to engage in collective efforts to solve community-wide problems. Here again, China distinguished itself as having a low IDV score, surpassed only by South Korea and Taiwan among countries with existing HSR systems.

In contrast, the United States has a very high IDV score, having not just the highest score among HSR countries, but also the highest among all countries measured. This could be an indicator of increased difficulty in rallying public support for a large HSR development endeavor, if the public in the United States view such an endeavor as either contrary to or not benefiting their interests. Generally speaking, however, there is no strong pattern of IDV scores among HSR countries.

The *Uncertainty Avoidance Index* is a measure of how much a culture is risk-averse when confronted with uncertain and unstructured situations. A high UAI score indicates a culture that is likely to favor strict laws and rules regulating situations where uncertainty is present. This could have bearing on HSR development in that HSR could be viewed as a way of regulating the uncertainty of growing populations or global warming. Alternatively, HSR could be viewed as a new and uncertain technology for those not already familiar with it and therefore could be shunned.

Among HSR countries, there is an apparent trend of high UAI scores, indicating that most countries with HSR prefer structure and rules for dealing with uncertainty. However, most of these countries are in Europe, in contrast with China, which has the second-lowest UAI among HSR countries. This could indicate that Europe, which is already comfortable with HSR, sees its expansion as a "known" variable for mitigating climate change, for example. China, with its low UAI, on the other hand, might be willing to embrace what, for them, is a new technology, for dealing with rapid growth, urbanization and economic expansion. On this measure, the United States has an average score, indicating neither a strong predilection for dealing with uncertainty through rules and regulations, nor a particular disposition for "winging it."

Long-Term Outlook is a measure of cultures' orientation towards the future. A high LTO score indicates a culture that values long-run results, even in the face of short-term set-backs. A low LTO score indicates a greater focus on tactical decisions, even at the expense of the long-term. LTO scores having a bearing on projects, such as HSR, which take a considerable amount of time to decide on, plan for, build and then, finally, start operating. Countries with high LTO scores might be more likely to be willing to undertake long-term projects that will not bear fruit for years.

Notably, China has a very high LTO score, as do the other Asian HSR countries Japan, South Korea and Taiwan. On the other hand, while there is more limited data available, western countries, including the United States, tend to have lower scores. This could indicate that, while Europe has a well-developed HSR system, its development might have come as an immediate response to pressing needs, rather than as part of a larger transportation infrastructure strategy. This could possibly have implications for the development of HSR in the United States, where such development might not be politically or popularly feasible until there is a perceived need to address an immediate problem or issue.

Finally, concerning culture, it should be noted that the dimensions measured here do not represent a comprehensive picture of culture in any given country. Furthermore, culture can also vary across and even within regions within a country, making generalizations difficult. There are many cultural factors than may play a significant role in the development of HSR in a country, or even within a given region, for example, the preference of people in some countries or regions of countries for cars over public transportation. Such cultural factors should also be given due consideration. Also, these measures should not necessarily be construed as definitively having an impact on HSR; they are only possibilities and factors to consider.

COUNTRY-SPECIFIC CONDITIONS AND FEATURES

This section seeks to highlight those conditions and features of countries salient for HSR that are either not readily apparent or are not available in aggregate or quantitative terms. These conditions and features include the geography of the country, its population centers, and its government, as well as features of its rail system, including a description of the ownership, operation, funding and governance of rail systems and HSR specifically.

Belgium

Country Conditions

In terms of landmass, Belgium is very small, about the size of Maryland. The terrain in Belgium is generally flat, with some hills and forests to the south. Belgium has a very high urbanization rate, at 97%, with most of the country's population concentrated in closely spaced cities to the north, with Brussels, the capital, having over one million residents. Belgium has a parliamentary government, with a complex mix of regionally and linguistically divided sub-

governments. These sub-national governments have responsibilities over transportation, among other broad responsibilities.[4]

High-Speed Rail

Belgium has four HSR lines, mostly providing international rail connections with France, Germany, and the Netherlands. The first line, to France, opened in 1997, line two opened in 2002, and lines three and four were completed in 2009, for a total of 209 km of HSR lines. Belgium currently has no plans to expand this network. A ticket from Brussels to Paris costs about $60[5] for the 260 km (160 mile) trip of one hour, twenty-two minutes.

The National Railway Company of Belgium (NMBS/SNCB) is the independent, state-owned infrastructure manager and operator in Belgium. In accordance with EU liberalization policies and regulations, Belgium split its previously monolithic railway company into three parts: Infrabel, which manages infrastructure and network operations and access, NMBS/SNCB, which manages freights and passenger operations, and NMBS/SNCB Holding, the parent company to Infrabel and NMBS/SNCB, which owns and supervises them. NMBS/SNCB receives large government subsidies.[6]

High-speed rail in Belgium is provided by four, soon to be five, international consortia, state-owned, and private operators, using NMBS/SNCB's tracks: Thalys, Eurostar, Intercity-Express, TGV, and (starting in the second half of 2010) Fyra. Thalys International operates the line from Brussels to Paris, as well as lines to Amsterdam and Cologne. It is divided up among the following owners: 62% held by the SNCF (France), 28% held by the SNCB (Belgium), and 10% held by Deutsche Bahn (Germany).

Eurostar connects Brussels with France, using the same tracks as Thalys and TGV. Eurostar is operated by Eurostar (UK) Ltd (EUKL), a subsidiary of London and Continental Railways (LCR) and holds 40% of the company, SNCF (France), which holds 35%, and SNCB (Belgium), which holds 15%. British Air is also a partner and holds 10%. In 2010, Eurostar was incorporated as a single corporate entity called Eurostar International, replacing the joint operation between EUKL, SNCF and SNCB.

Intercity Express (ICE) is a German HSR trainset manufacturer/operator. TGV is an HSR operator and subsidiary of SNCF, the French national rail company and operates on Thalys network tracks. Fyra is an HSR operator that uses the Thalys network as well, and operates connections between Brussels and the Netherlands. Fyra is a joint venture of NMBS/SNCB and NS Hispeed (a joint venture of the Dutch national rail company, NS (90% holdings), and the airline KLM (10% holdings)).[7]

China

Country Conditions

Only slightly smaller than the U.S., China is one of the largest countries with HSR, in terms of population and land mass. The terrain is a mix of plains, hills and deltas to the east, and mountains, high plateaus and deserts to the west. Most population centers in China are located in the east and south. Beijing is the capital city (pop. 7.7 million), located in the northeast. Other major cities include Shanghai (pop. 10 million) located on the east coast, Tianjin (pop. 4.9 million), located just south of Beijing, Shenyang (pop. 4 million), located northeast of Beijing, Wuhan (pop. 4.6 million), located south of Beijing, Guangzhou (pop. 4.6 million), located on the southern coast of the country, Chongqing (pop. 4.2 million), located towards the middle-southern part of the country, Harbin (pop. 2.7 million), located in the far northeast, and Chengdu (pop. 2.6 million), located in the middle-south of the country. Most of China's recent, rapid economic expansion and modernization have occurred in the eastern and east coast regions of the country, which is also where most of China's HSR is located.

The Chinese government is highly centralized and subordinate to the Chinese Communist Party (CCP). The CCP coordinates policy and directs the government to implement its policies. Control by the CCP is strongest in the government and in urban, industrial and economic spheres. In China, administrative divisions comprise 23 provinces (including, nominally, Taiwan), 5 autonomous regions and 4 municipalities (the latter including Beijing, Chongqing, Shanghai and Tianjin).[8]

High-Speed Rail

In just the last few years, China has embarked on an unprecedented effort to invest in and build a vast HSR network. With over 3,500 km of HSR lines in operation (most brought online just in the last 4 years), it now exceeds even Japan, the previous HSR infrastructure leader, by almost 30%. And the pace of growth is not slowing. With rail use increasing 30% each year, China spends 9% of its GDP on infrastructure ($160 billion, annually for new projects) and plans to invest $300 billion ($231 per capita) of that on HSR projects through 2020. This investment will go towards completing construction on 6,700 km of HSR lines and building an additional 2,900 km of new lines.

Most of the 10 existing HSR lines are concentrated in the east of the country, between such large population centers as Beijing and Tianjin, Wuhan and Guangzhou. Lines under construction, as well as those planned, will create a network of HSR that will connect most of eastern China's large cities. Fares range, but, for example, a second-class ticket from Beijing to Tianjin, a trip of 110 km (70 miles), costs $8 and takes about 30 minutes, an hour less than previous trains. The Beijing-Tianjin line was recently completed in time for the Beijing Olympics, travels at speeds of up to 350 km/h, and cost $2.9 billion to build.[9]

China also has among the most sophisticated HSR systems worldwide, with the only commercial "magnetic levitation" train in the world, reaching speeds of 431 km/h, and several of its conventional lines reaching speeds of 350 km/h. This has been the result of a government mandate to build state-of-the-art systems, and has led to a great investment in technological research. China has gained sufficient expertise in HSR technology that it has even begun to export its know-how and has offered its assistance to California in constructing its HSR network.

With regard to governance, China has a very centralized government, with strong command-and-control structures in place that enable it to quickly take action and direct resources towards chosen policy goals, such as building a sophisticated, ubiquitous HSR network connecting the country. Prior to economic and other reforms began in the late 1970's, railways were entirely dependent on the state, and foreign investment was discouraged. However, after reforms, the government has allowed loans from national banks, as well as bonding for construction. Since 1984, the government has allowed

loans from the World Bank, other development banks, and loans from the Japanese and German governments. Nonetheless, tight government control over the operations of HSR and all rail transport remains.[10]

France

Country Conditions

Just smaller than Texas, France's landscape varies from plains and rolling hills throughout much of the north and west, to the Pyrenees mountains to the south and the Alps to the east. Major cities include Paris, the capital (pop. 11.8 million) and Lille (1.2 million) in the north, Lyon (1.8 million), Marseilles (1.6 million) and Nice (1.2 million) in the south west and on the coast of the Mediterranean, Toulouse (1.1 million) and Bordeaux (1 million) in the southwest and Nantes (800,000) on the west coast. France has a presidential republic with a parliament. Power is very centralized in the national government, with only some administrative and fiscal power delegated to regional and local authorities.[11]

High-Speed Rail

France has among the largest HSR systems in the world, particularly compared to its land mass. With almost 1,900 km of HSR lines, France comes behind only China and Japan in existing infrastructure. And, assuming planned lines are built, it will have 4,700 km in the future, ahead of Japan and behind only China (with a future 13,000 km) and Spain (with 5,500 km). France has operated HSR lines since the early 1980s and currently has seven lines in operation connecting most of the major cities across the entire country, with all lines reaching speeds of 300 km/h or more. In terms of fares, a trip from Paris to Lyon (a distance of 390 km/245 miles), by TGV (France's high speed trains), costs $70 and takes two hours.

At inception, and until 1997, France's public railway company, Société Nationale des Chemins de Fer Français (SNCF) was fully integrated, with responsibility for operations and infrastructure, and with 100% of its assets owned by the state. Prior to 1997, SNCF was carrying $25 billion in debt and was running a $2.4 billion deficit. This prompted a restructuring of SNCF and its financing. Reform resulted in the creation of Réseau Ferré de France (RFF), a public company with responsibility for managing infrastructure. Like SNCF, all of RFF's assets are state-owned. RFF is responsible to improve existing lines, develop new lines, and enhance the network by selling land and lines not in use.

RFF derives income from access charges for use of the rail network, income from land properties associated with the network, and state subsidies. When RFF was created, two-thirds of the formerly integrated SNCF's debt were transferred to RFF in exchange for SNCF's infrastructure assets, including 31,000 km of track. Despite the fact that RFF manages infrastructure, SNCF provides infrastructure management services, under contract, for RFF, including traffic management on the national network and maintaining the national safety system. Reform also led to the creation of 21 geographical regions in France, each with the ability to purchase service from SNCF, which retained responsibility for operations. Regions enter into contracts with SNCF to purchase service, based on the quantity and frequency of service required to meet the individual regions' needs.

The French Ministry for Transport provides all of the funding, in the form of subsidies, for SNCF, RFF and the regions that purchase service from SNCF. The subsidy to the rail system totals $9.6 billion each year, including $2.5 billion allocated to the 21 geographic regions to purchase service from SNCF. The state provides RFF with $1 billion to pay off its debts inherited during reform and approximately $1.1 billion for infrastructure renewal; the cost of maintenance itself is covered by rail access fees RFF charges to SNCF.

Since reform, RFF's debt has stabilized and, as infrastructure access fees have continued to rise, public subsidies for RFF have been decreased proportionately. A public financial agency was recently created to provide RFF with infrastructure subsidies and zero-percent interest loans for new projects. RFF receives about $1.8 billion annually for infrastructure investment. Concerning HSR specifically, France plans to spend $75 billion through 2020, which equates to $1,172 per capita and 0.36% of GDP annually.[12]

Approval of new rail projects is contingent on a socio-economic appraisal, including a rate of return of at least 8%. It should be noted here that every TGV line built so far has covered its construction costs within a few years of operation and has also resulted in significant shifts of traffic from road and air to rail. Also of note is the current construction of the Perpignan-Figueras HSR line, which will be the first HSR line built in France within the framework of a public-private partnership.[13]

Germany

Country Conditions

Geographically, Germany is a little smaller than Montana, with low plains in the north, high plains and hills in the center and east and mountains to the south. Major population centers include Berlin, the capital (pop. 3.4 million), and Hamburg (1.8 million) in the north, Munich (1.3 million) in the south, and Cologne (1 million) and Frankfurt (640,000) in the west. Germany is a federal republic with a parliament and 16 Laender (states), with representatives from each state in the upper house of parliament. Revenue for the states is shared with the national government and is regulated by the concurrence of both houses of parliament.[14]

High-Speed Rail

In terms of network size, Germany's HSR system currently ranks fifth in the world, with about 1,300 km of lines in operation, behind China, Japan, France and Spain. Germany plans, over the next few years, to construct an additional 1,000 km of lines. With over 10 operating lines, HSR connects many of the country's population centers and all rail in Germany has an 8.4% share of the passenger transportation market overall. However, most German HSR lines operate at top speeds of 250-280 km/h, somewhat slower than other European countries with HSR. As an example of fares, a trip from Berlin to Hamburg (a distance of 255 km (160 miles) costs about $100 and takes 1 hour 50 minutes.

Until 1994, railway service was provided by two public companies, Deutsche Bundesbahn (West Germany) and Deutsche Reichsbahn (East Germany). In 1994, the companies were merged to form the Federal Railway Property Agency (BEV). The commercial part of BEV was then separated and DB was formed, a state-owned, joint stock company with separate units for long- and short-distance passenger rail and infrastructure management. Responsibility for the $38 billion in debt inherited by DB was transferred to BEV and the national government pays between $8.5 and $12.7 billion annually

to BEV for debt service and other administrative responsibilities, such as pensions.

DB owns all rail infrastructure in Germany, however, the state holds all of the shares of the infrastructure management unit of DB, DB Netz. All operators, including DB, pay DB Netz access fees for use of rail infrastructure. The government provides DB with about $5.1 billion per year to renew and develop infrastructure, of which $3.2 billion is for maintenance and $1.9 is to renew and develop new infrastructure.

There is currently a debate on whether DB should move to becoming a publicly traded company, with the outstanding issue being whether DB Netz, along with its infrastructure holdings, should be part of the initial public offering. While proponents argue that there would be significant financial benefits from an integrated initial public offering, detractors worry that this would lessen the government's ability to influence infrastructure decisions. Increases in the age and declines in numbers of the population in Germany as a whole will increase pressure on the national budget and could lend additional support to privatization efforts.

At the time of reform, the rail market was also opened to competition for rail operators to bid on contracts for providing service to Laender (states). While there are currently around 300 such service providers, DB remains the primary provider in most markets. States in Germany are provided with funding from the national government to purchase service from operators.

Annually, this funding totals $8.9 billion and is granted in the form of subsidies from the national transportation fund, which is, in turn, supported by a motor vehicle fuel tax. Operators bid based on the specifications outlined in states' request for proposals. Contracts are typically for 10-15 years. States are not required to purchase service from independent operators, opting instead to purchase the services of DB. States are also free to purchase service for amounts above their subsidies, using their own funds, if they so desire. Some states have further devolved authority for rail service to the local level.[15]

Italy

Country Conditions

Italy is a primarily rugged, mountainous country that is slightly larger than Arizona in size. Major metropolitan areas include the capital Rome (pop. 2.8 million) located in the center of the country, Naples (975,000), located south of Rome, and Milan (1.3 million) and Turin (900,000 million) in the north. Italy's government is a republic, with a parliament, 94 provinces and 20 regions. The government is very centralized, with the prefect of each province appointed by and answerable to the central government. Regions have limited governing powers.[16]

High-Speed Rail

Italy has operated HSR trains since 1978, when it opened its Rome-Florence line, which reached speeds of close to 250 km/h. With the exception of expansions of the Rome-Florence HSR line in 1984 and 1992, little was done to upgrade rail infrastructure or expand HSR service for some time. Then, starting in the early-2000s, rail, including HSR, became a priority, resulting in heavy investments in the form of both one-time and ongoing expenditures to modernize Italy's rail network. One main reason for investing in HSR has been that the conventional rail network has reached capacity in some areas and the move to HSR for long-distance trips has freed track for the needed expansion of regional and freight rail.

In 2004, the government increased capital funding to $2.9 billion per year, half of which went to HSR projects. Starting in 2006, new HSR lines began to operate, and in 2007, the government committed to spend $20.9 billion for expanding its HSR network. Since then, the number of HSR lines has grown to seven total (not including the two expansions of the Rome-Florence line), and HSR serves much of the country.

With over 900 km of HSR lines in operation, Italy has plans to expand HSR service by an additional 400 km of lines in the future, however, expansion beyond that is unlikely as the system is relatively self-contained. Almost all of these new HSR lines operate at speeds over 300 km/h; however, the average speed of these trains is somewhat less than in other HSR countries, due to the frequent stops made by long-distance trains to serve the dispersed population. Fares from Rome to Florence are $60 for a trip of 230 km (about 140 miles), which takes about 1.5 hours; this is twice as fast as the regular train, which costs about $40.

The national Italian rail network is owned and operated by the fully state-owned entity, FS (State Railway) Holdings. FS Holdings has three operating subsidiaries, including: Trenitalia, which operates freight and passenger trains; RFI, which manages infrastructure; and TAV, which is responsible for the planning and construction of HSR lines. Regional and local rail networks are managed separate from the national rail network and are managed by the regional governments.

Despite the governments singular role in managing railways in Italy, privatization could become increasingly likely as the population of the country declines and ages, putting stress on governments budgets. Competitive pressure on the state-owned railways could also increase as private operators, such as NTV come online. NTV is a private rail operator that has begun a $1.4 billion HSR project to connect both northern and southern Italy's major cities. Service is expected to begin in 2011 and will use existing HSR track and new AGV HSR trains. While NTV will not likely be able to compete with state-owned HSR lines in terms of speed or price, it plans to offer better service and quality.[17]

Japan

Country Conditions

Japan is a mostly rugged, mountainous country, slightly smaller in size than California. Major population centers include Tokyo, the capital (pop. 8.5 million), Yokohama (3.6 million), Osaka (2.6 million), Nagoya (2.2 million), Kobe (1.5 million), and Kyoto (1.5 million), all located in central Japan, as well as Sapporo (1.9 million), located in the north, and Fukuoka (1.5 million), located in the south. Japan has a constitutional monarchy with a parliamentary government. In Japan, there is no federal system of government, but rather a highly centralized system, with 47 prefectures which are dependent on the national/central government.[18]

High-Speed Rail

Japan has the oldest commercial HSR (Shinkansen) network in the world, with the first trains in operation in 1964. While not the

largest, Japan has what is most likely the most comprehensive and integrated HSR system of any country in the world, with 2,452 km of HSR routes. It has high-speed rail lines covering most of the country. Most of Japan's population is concentrated in 20 percent of its land area in densely populated, large cities. This geographical situation is ideally suited for intercity passenger rail service.

Intercity passenger trains enjoy an 80 percent market share of all intercity passenger trips 200-400 miles in length. HSR lines connect major metropolises and are the busiest high-speed rail lines in the world, with the Tokyo--Osaka (Tokaido) line operating trains that depart, at peak hours, six times per hour and with the capacity to accommodate 1,300 passengers per train. Fares vary, based on the type of ticket purchased, from monthly passes which cost around $600, to single-trip fares, for example, from Tokyo to Osaka, a 400 km (250 mile) trip, (a little less than the distance between Los Angeles, CA and Las Vegas, NV), costing $90 and taking about 2.5 hours. However, it should be noted that many employees receiving monthly/yearly passes from their employers.

Prior to 1987, the entire Japanese railway system was fully integrated under Japan National Railways, a single state entity, which had considerable costs and incurred substantial debt. In 1987, reform separated the single railway entity into six smaller, private railways, based on geography (with a separate company for freight rail, JR Freight). Doing this allowed the entities to be vertically integrated, or responsible for both operations and infrastructure within their respective geographic regions. Of the six railways, three (JR East, JR Central and JR West) are located on the mainland and the remainder (JR Hokkaido, JR Shikoku and JR Kyushu) are located on Japan's major islands.

The three mainland companies, JR East, JR Central and JR West, are fully privatized and receive no financial support from the government. At the time of reform, Japan National Railways (the previous state-entity) had incurred debt, totaling $255.8 billion. Of that, $176.3 billion was placed in a new entity, the Japan National Railways Settlement Corporation, with the remainder of the debt distributed among the three mainland railways, JR Freight, and the Shinkansen Holding Company. The three smaller railways were exempted from shouldering this debt due to their less favorable financial prospects.

To support the three smaller railway companies, during reform, the Japanese government created a "Business Stabilization Fund," with allocations for each of the smaller railways, JR Hokkaido, JR Shikoku and JR Kyushu, in order to support them. The three smaller rail entities are allowed to use interest-earned on their respective funds for operations and capital improvements, but are not allowed to draw on the principal balance of the fund. In addition to this aid, the government offers a guaranteed interest rate for the "Business Stabilization Fund" which exceeds the market rate available to the three mainland rail entities. The government has reduced the tax rate on fixed railroad assets as well. The smaller three railways continue to be subsidized, with JR Kyushu deemed as the only one of the three likely to be fully privatized in the future.

Concerning construction and ownership of HSR lines, The Japan Railway Construction, Transportation, and Technology Agency actually builds new lines and retains ownership of some existing HSR lines, leasing them to the railway companies for HSR use. Japan continues to expand its HSR system. Through 2020, Japan plans to invest $50 billion in HSR development. This translates into about $400 per capita investment or 00.12% of annual GDP.[19] These funds will be for completing the construction of four lines, 590 km in length, and for the planning and construction of three additional lines, 583 km in length. While Japan budgets more than 10% of its government spending on infrastructure, with generous investments in transportation and utility systems, a declining and aging population has led to cuts in infrastructure, a trend that is expected to continue.[20]

Netherlands

Country Conditions

The Netherlands is a small, mostly coastal-lowland country about twice the size of New Jersey. The major cities include the capital, Amsterdam (pop. 760,000), The Hague (the seat of government, pop. 483,000), Rotterdam (583,000), and Utrecht (300,000). All are clustered closely together near the center-coast of the country. The Dutch government is parliamentary in nature, with nationally elected members of parliament. There are 12 provinces, governed by provincial councils, council executives and commissioners, with the latter being appointed by the queen.[21]

High-Speed Rail

The Netherlands has one HSR line, 120 km long, connecting Amsterdam (along with several other major Dutch cities) to Brussels and thereby to the European HSR network. Previous plans to expand the HSR network have been put on hold. A ticket from Rotterdam to Brussels costs $57 for the 120 km (75 mile) trip of one hour twelve minutes. Two operators, Thalys and Intercity Express currently provide HSR service. A third, Fyra, will begin to provide HSR service starting in the second-half of 2010.

Thalys International is an international consortium, with its capital divided up among SNCF (the French national railway company), with 62%, SNCB (Belgium national railway) with 28%, and 10% held by Deutsche Bahn (Germany national railway). Intercity Express (ICE) is a German HSR trainset manufacturer/operator. Fyra is a joint venture of NMBS/SNCB and NS Hispeed (in turn, a joint venture of the Dutch national rail company, NS (90% holdings), and the airline KLM (10% holdings)).

Prior to 2003, Dutch Railways (NS) was a single, state-owned railway company that owned, operated and maintained the national Dutch railway network. As a result of EU market liberalization regulations, NS split in 2003 into NS, the national rail operator, and ProRail, the infrastructure ownership and management company. While NS continues to be the main service provider for primary rail lines, several other private operators and one other public operator have emerged to provide service on secondary lines. In addition to HSR operators Thalys and ICE, which are foreign-owned, NS owns 90% of the HSR provider, NS Hispeed, as mentioned above, which is, in turn, a part-owner of the Belgian/Dutch HSR operator, Fyra.[22]

South Korea

Country Conditions

South Korea is a small country, about the size of Indiana. The terrain is mountainous, with deep, narrow valleys, except along the coasts and in the west and south, where there are plains. Major population

centers include the cities Seoul (the capital, pop. 10.3 million) and Incheon (2.6 million) in the north of the country, Daegu (2.5 million) and Daejeon (1.5 million) in the middle, and Busan (3.7 million), Gwangju (1.4 million), and Ulsan (1.0 million) in the south. South Korea is a republic with a strong executive branch, headed by a president. At the sub-national level, there are nine provinces and seven separately administered cities. Regional and local governments are semi-autonomous, with their own executive and legislative bodies.[23]

High-Speed Rail

South Korea's HSR line, the Korean Train Express (KTX), running 330 km from Seoul to Daegu, began operations in 2004, 12 years after construction began. KTX now allows the entire country to be reachable within three hours. Since inception, daily ridership has risen to close to 85,000, and it is reckoned that KTX has lured 56% of existing rail, 17% of air, 15% of express bus, and 12% of highway traffic. The ride from Seoul to Daegu, a journey of 235 kilometers (about 145 miles), takes one hour forty minutes and costs $30.

KTX is currently constructing an extension of its HSR line to reach Busan, South Korea's second most populous city after Seoul. The costs of the first phase of construction, from Seoul to Daegu, have been $10.6 billion and it is estimated that total costs will reach $15.3 billion once the entire project and line are complete.

The rail system in South Korea is state-owned and is overseen by the Construction and Transportation Ministry. The South Korean government has a history, over the past few decades, of massive investment in transportation infrastructure. Funding for the KTX project was derived from the government budget, from loans, and from the budget of the Korea High-speed rail Construction Authority (KHRC). Government rules mandate that up to 65% of projected costs of new HSR lines be funded by the operator.[24]

Spain

Country Conditions

Spain is a country about the size of Utah and Arizona combined, with high plateaus, lowland plains near the coasts, and mountains in the north. Major cities include the capital, Madrid (pop. 5.5 million), located near the center of the country, Bilbao (353,950) along the north coast, Barcelona (4.9 million), Valencia (2.3 million), and Zaragoza (871,000) in the west and along the west coast, and Seville (1.8 million) and Malaga (1.3 million) along the southern coast. Spain has a parliamentary democracy with 17 regional autonomous governments. The national government continues a process of devolving powers to the regional governments, which will eventually have full responsibility for health care, education and other social programs.[25]

High-Speed Rail

Spain has one of the largest HSR networks in the world, at 1,600 km and 10 HSR lines, linking most of the country, behind only China, Japan and France, all of which have significantly larger land areas and populations. All but the Madrid-Seville line (which started operating in 1992) have come online since 2003; this is partly the result of the fact that passenger rail transport rose 30% between 1990 and 2000, even though the average annual distance traveled (316 miles) is still less than the European average (502 miles). Fares from Madrid to Seville, a distance of 390 km (240 miles), are about $100, with the trip taking about 2.5 hours.

Spain also has one of the most ambitious HSR expansion plans, with 13 new lines (2,200 km) under construction and another 10 lines (1,700 km) planned, all of which will result in almost the entire country being linked into one of the most dense HSR networks in the world, with over 5,500 km of lines. This massive expansion effort is the result of the government's promise to link all of the country's provincial capitals to Madrid within 4 hours by train and Barcelona by 6 hours.

There are three passenger rail operators in Spain, one state-owned company, RENFE, and two private companies, which provide long-distance service on their own tracks. RENFE is controlled by the ministry of public works and is funded primarily by the central government, but also receives funds from regional governments, which participate in rail planning. Because EU law mandates the separation of rail operations and infrastructure, the national government has proposed the creation of a new state-owned company to manage infrastructure and construct and maintain new lines.

In terms of finance, Spain has committed a large amount of resources to the development of passenger rail and HSR. Spain's Strategic Infrastructure and Transport Plan (PEIT) calls for Spain to, through 2020, invest $136 billion in HSR development, the equivalent of $3317 per capita or almost 1% of GDP annually, by far the biggest commitment to HSR development worldwide.[26] It should be noted, however, that Spain's ability to follow through on these investments and plans could be complicated by two factors. First, while Spain has much lower HSR construction costs when compared to other European countries, it will no longer be receiving money from the EU Regional Development Fund (an EU fund that promotes economic development, infrastructure modernization, and innovation), as it has in the past. Second, Spain's recent public debt problems could complicate its ability to borrow funds at reasonable rates in order to finance its massive HSR expansion efforts, or borrow funds at all if the EU and/or IMF decide to impose austerity measures as a condition of restructuring Spain's public debt.[27]

Switzerland

Country Conditions

Switzerland is about twice the size of New Jersey, with most of the landscape being covered by mountains, and the remainder by hills, plateaus and large lakes. Major population centers include the capital, Bern (pop. 123,000), located in the center-west of the country, Geneva (180,000) and Lausanne (119,000), located in the southwest, and Zurich (359,000) and Basel (164,000), located in the north. Swiss government is federal, comprising 26 cantons, which have fiscal independence from the national government and significant autonomy with regard to their internal affairs. Cantons retain all powers not specifically delegated to the federation, similar to the relationship of states to the federal government in the United States.[28]

High-Speed Rail

Swiss high-speed rail is limited to one 35 km line running through the Lötschberg base tunnel, one of the longest land tunnels in the world. The line was built in order to connect the Canton of Bern, where the capital city is, to the Canton of Valais, a popular ski resort area. Switzerland is in the process of building two additional HSR base tunnels that will serve similar purposes. Service from Frutigen to Visp (stops on either side of the Lötschberg base tunnel), a trip

of 35 km, costs $62 and takes a total of 49 minutes, including a necessary 12 minute transfer.

The owner and operator of the Lötschberg Line is the Bern-Lötschberg-Simplon (BLS) railway. It is a regional operator and is the largest private Swiss railway company. A 2006 merger saw Regionalverkehr Mittelland AG and BLS Lötschbergbahn AG consolidated into BLS AG. Under the merger, owners include the Canton of Bern (55.8%), the Swiss Confederation (21.7%), and other cantons and private parties (22.5%). As a result of this merger, BLS AG became the second-largest standard-gauge railway company in the country, after the Swiss Federal Railway company.[29]

Taiwan

Country Conditions

Taiwan is an island country about the size of Maryland and Delaware combined. Two-thirds of the country are covered by mountains, mostly in the eastern portion, and the remainder is flat and rolling plains, mostly in the west. Major cities include Taipei (pop. 2.6 million), the capital located on the northern end of the island, Kaohsiung (1.5 million) in the south, and Taichung (1.07 million) on the central-coast of the country. The Taiwanese political system comprises a multi-party democracy, with a president and national assembly of legislators. At the sub-national level, Taiwan has 18 counties, 5 municipalities, and 2 special municipalities (including Taipei). Since 1998, however, the position of elected provincial governor has been abolished in favor of administering counties and cities directly through the national executive branch.[30]

High-Speed Rail

Taiwan has one HSR line running from Taipei, in the north of the oblong island, 345 km (214 miles) to Kaohsiung, in the south, passing through most of the major population centers in the country. Construction of the line began in 2000 and concluded in 2007. Fares from Taipei to Kaohsiung are about $45 for the 90 minute trip, a significant improvement over the previous four hour conventional train ride. Currently Taiwan has no additional HSR lines planned.

While the Taiwan Railway Administration (TRA) runs most passenger and freight lines around the country, Taiwan's HSR line is somewhat unique in that it was constructed and is currently operated under a Build-Operate-Transfer (BOT) arrangement between the government and the Taiwan High-speed rail Corporation (THSRC). In exchange for THSRC building the high-speed rail line, the state allowed THRSC the concession of operating the line for 35 years (starting in 1998), by which time THSRC will hope to have made a profit on the project, after which it would be turned over to the government. The Taiwan High-speed rail (THSR) project from Taipei to Kaohsiung is one of the largest privately funded rail construction projects in the world, valued at $13 billion. Rolling stock includes 30 HSR trains valued at $31 billion.

While THSRC's runs an operating profit, interest payments, depreciation and amortization have sapped this surplus and generated losses. Additionally, after a $770 million net loss in 2008, THSRC's shareholders signaled reluctance to invest further in the project, which has led to difficulty for THSRC in securing financing from banks as well. While the government and several state-owned companies have stakes in THSRC and a public interest in seeing the system succeed and operate smoothly, the government has indicated that it is neither interested in taking over the company nor investing more in it. However, THRSC has recently picked a new, government-backed chairman, allowing the government more of a supervisory role in the company, a move that is viewed as way of persuading creditors to issue loans to THSRC at interest rates that will allow it to remain solvent.[31]

Turkey

Country Conditions

Turkey is a country slightly larger than Texas, with a high central plateau surrounded by narrow coastal plains and with several mountain ranges. Large population centers include the cities Ankara (the capital, pop. 4.5 million), located on the central plateau, Istanbul (11.8 million), Izmir (3.4 million), Bursa (1.5 million), located in the west of the country and along the west-coast, and Adana (1.5 million) and Gaziantep (1.2 million), located in the south. Turkey has a parliamentary democracy, with 81 provinces at the sub-national level. Provincial and municipal officials are elected locally.[32]

High-Speed Rail

In 2003, Turkey began construction on its first HSR line, from Ankara to Eskisehir, the first section of a line running from Ankara (in central Turkey) to Istanbul (on the northwest coast), the country's two largest cities. The first line began operations in 2009 and there are currently plans to expand HSR service throughout much of the country, with two lines due to begin operating in 2011 (including the final stretch of the Istanbul line) and an additional five lines in the planning stages. The network, if built as planned, will total over 2,400 km of lines. Service from Ankara to Eskisehir, a 200 km (124 mile) distance, costs $13 and takes 90 minutes.

The Republic of Turkey General Directorate of State Railways Administration (TCDD) is a state-owned and controlled rail company, operating under the supervision of the Ministry of Transport. TCDD is the sole rail operator in Turkey and is in charge of operations and infrastructure, as well as managing some ports and ferry services in the country. TCDD regularly has financial losses and receives significant subsidies from the state.

TCDD has three affiliate companies, whose activities it coordinates: Tulomsas (Locomotive and Motor Corporation of Turkey) manufactures locomotives under licence; Tuvasas (Wagon Industry Corporation of Turkey) manufactures passenger coaches: Tudemsas (Railway Machines Industry Corporation of Turkey) manufactures freight wagons. However, Turkey has imported HSR trainsets for use on its HSR network.[33]

United Kingdom

Country Conditions

The United Kingdom (UK) is an island nation slightly smaller than Oregon. Terrain is mostly rugged hills and low mountains, with flat and rolling plains in the east. Major cities include the capital, London (pop. 7.2 million), in the southeast, Bristol (421,000) in the southwest, Leeds (443,000), Liverpool (469,000), Manchester (394,000), Sheffield (440,000), and Birmingham (971,000) in central England, and Glasgow (630,000) and Edinburgh (430,000) in Scotland in the north.

The UK has a parliamentary government that can legislate both for the country as a whole and for the constituent parts of the country.

However, Northern Ireland, Scotland and Wales have varying forms of "devolved" governments, with their own parliaments or assemblies. These devolved governments have a varying range of legislative and administrative powers over areas not reserved by the central government. Local government is a complex mix of administrative spheres of influence both among and within Northern Ireland, Scotland, England and Wales, with no common administrative unit.[34]

High-Speed Rail

While it has a large passenger rail network covering most of the country, the UK currently has relatively limited HSR, with service connecting London to Europe via the English Channel Tunnel, or «Chunnel.» This line has been dubbed «High Speed 1.» The UK plans to expand its HSR network by building a line, «High Speed 2,» which will connect central London and Birmingham. Through 2020, the UK plans to invest $50 billion in HSR, which equates to $820 per capita and 0.23% of GDP annually.[35] Fares for the trip from London to Paris, a distance of 345 km (215 miles), cost as little as $60 and takes 2.5 hours on a train that reaches speeds of 300 km/h.

Prior to 1993 the UK's railways were owned, operated and controlled by the monolith, British Railways. Reform took place in 1993, spanning five years and then again in 2004. The initial reform saw the privatization of rail, breaking up British Railways into several components, including the private infrastructure company, Railtrack, which was replaced with Network Rail in 2002. Twenty train operating companies, three rolling stock ownership and leasing companies, and three government regulators (later merged into one, the Office of Rail Regulations) were also created. The 2004 restructuring included reforms to improve performance, efficiency, and safety, as well as to reign in expenditures.

After the 1993 reforms, private operators were allowed to bid on franchises to provide services, however the government continues to subsidize unprofitable services and receive payments from services that are excessively profitable. While the government expects its subsidies to decrease in the future, it currently covers about 50% of the costs of railway operations. Operators pay access fees to Network Rail, the private infrastructure company, and have their subsidies or payments to the government adjusted, depending on changes in access fees. The government also plays a role in setting the strategic direction for the railways. Budget deficits have led the government to seek to expand public-private partnerships with rail and, while this has resulted in better on-time performance for trains, prices to riders have increased.

In 2002, Network Rail bid to take over the bankrupt Railtrack and inherited both Railtrack's infrastructure and $1.5 billion of debt. Networks Rail currently manages all rail infrastructure in the UK It is a private corporation run by a board of directors and is overseen by 100 members of the rail industry, as well as private citizens. These members are not involved in the day-to-day operations of Network Rail, but elect and dismiss board members, approve board member compensation, approve the annual report, and approve specific resolutions.

Network Rail has three sources of income, including network access fees paid by operators (which are set by the Office of Rail Regulation), government grants, and income from sources such as commercial property. Currently, Network Rail has $34 billion in debt, an amount that is expected to have peaked at $37 billion, most of which has been used to finance enhancement to its regulatory asset base.[36]

United States

Country Conditions

In geographic terms, the United States is about half the size of Russia or South America and slightly larger than either Brazil or China. Terrain varies from low mountains and hills in the east to a vast central plain and high mountains in the west. Cities with the largest metro area populations are scattered across the country and include New York (pop. 19 million), Philadelphia (5.8 million), Washington DC (5.4 million) and Boston (4.5 million) along the upper east coast, Dallas (6.3 million), Houston (5.7 million), Atlanta (5.4 million) and Miami (5.4 million) in the southeast, Chicago (9.6 million) in the upper Midwest, and Los Angeles (12.9 million) on the west coast.[37]

The United States is a constitutionally based, federal republic. Compared to sub-national government units in most other countries, states in the U.S. enjoy a considerable amount of autonomy and say over internal affairs. The federal government reserves the right to intervene in areas outlined in the Constitution of the United States, including the right to regulate interstate commerce, which has been broadly interpreted to apply to many types of cross-state-border activities.

High-Speed Rail

High-speed rail in the United States is limited to one line, the Acela, running through the Northeast Corridor (NEC), from Washington D.C. to Boston. The Acela trains reaches speeds of 240 km/h (technically excluding it from the international high speed definition), but it averages less then half of that over the length of the line. The Acela line is run by Amtrak, the national rail service and a state-owned and supported corporation. Fares on Acela for a trip from Washington D.C. to New York are $135 for a 2.75 hour trip covering 330 km (205 miles).

Recently, the United States announced ambitious HSR expansion plans, designating 11 corridors across the country as targets for funding the expansion of HSR in population-dense areas. Through 2020, approximately $13 billion have been appropriated (including a recently announced $8 billion) for HSR expansion. While this represents only a $42 per capita or 0.009%, the High-Speed Intercity Passenger Rail (HSIPR) Program is accepting applications for funding, which could result in additional appropriations.

Of the 11 announced corridors, the only one in advanced planning stages, and likely to begin construction soon, is the Los Angeles-Sacramento line, 900 km in length, that will connect much of California to HSR. The main obstacles to HSR expansion are identified by the Government Accountability Office (GAO) as high up front costs of capital and sustaining support and building consensus over the long run.[38]

The Rail Passenger Service Act of 1970 created Amtrak to provide U.S. intercity passenger rail service because existing railroads found such service unprofitable. Today, Amtrak continues to be the main provider of intercity passenger rail service in the United States, operating a 22,000-mile network that provides service to 46 states and Washington, D.C., primarily over tracks owned by freight railroads. Federal law requires that freight railroads typically give Amtrak trains priority access and, in general, charge Amtrak the incremental cost—rather than the full cost—associated with the use of their tracks.

Amtrak also owns about 650 miles of track, primarily on the Northeast Corridor (NEC), which runs between Boston, Massachusetts, and Washington, D.C. Access to this corridor is also critical for the operations of nine commuter railroads run by state and local governments serving 1.2 million passengers each work day. According to Amtrak, four freight railroads also use the corridor each day.

Amtrak also provides long distance service on 14 routes, which Amtrak fully funds, with 45% of Amtrak's passenger miles coming from these routes. Additionally, state-supported Amtrak intercity service, in corridors usually 100-500 miles in length, accounts for 35% of Amtrak's daily service and about half of passenger trains in the system. In such cases, states provide funding to help cover operating deficits incurred by Amtrak. Amtrak's Acela line and Northeast Corridor are profitable in terms of fares covering the costs of operation, but revenues do not cover major capital investments. Amtrak receives federal funding of approximately $1.3 billion annually, however, it is estimated that Amtrak will need an additional $5 billion total in order to cover the costs of performing the maintenance necessary to bring its infrastructure to a good state-of-repair.

From 1997 until 2000, the U.S. invested about 6% of GDP in transportation. This included 5% of GDP (83% of the total) for rolling stock, such as aircraft, boats and motor vehicles, 0.9% of GDP (14% of the total) for infrastructure, and 0.15% of GDP (3% of the total) for transportation equipment, such as computers. The government is the main investor in highway, transit, airport and other transportation infrastructure. The business sector is the main investor in railways, however these investments have been decreasing significantly over time.[39]

SUMMARY OF RESULTS AND PRELIMINARY CONCLUSIONS

In summary, it is possible to draw several broad, preliminary conclusions about HSR systems worldwide and the conditions in the countries in which they operate. With regard to conditions in countries that have HSR systems, several things seem evident.

Political Conditions

First, in terms of political conditions, most countries that have HSR systems have relatively centralized governments compared to the United States. Most HSR countries have strong national governments that have very close ties and authority over, or provide significant funding for, regional, state, or local governments. This allows decisions to be made in more of a top-down manner, where national directives are implemented without much resistance from regional or local government. In contrast, the United States has a strong federal tradition, with states enjoying a great amount of autonomy compared to sub-national governments in other countries.

States in the U.S. have control over their own budgets and are able to pass laws and make policy independently, compared to sub-national government in other countries. In Germany and Switzerland, which both employ federal systems, they either have much more integration between the states and the national government compared to the U.S. (in the case of Germany) or they have very little coordination and implementation of HSR nationally (in the case of Switzerland). It is notable that the only country even close to the size of the U.S. that has HSR, China, has a very centralized government, with top-down decisions being the norm.

Also, because HSR systems usually span sub-national jurisdictions, national involvement in the implementation of HSR is often required. National, or federal, involvement often requires the creation of regulations and conditions to which sub-national governments must submit. States' autonomy and states' rights issues make such coordination more difficult, due to variances in states' goals and their willingness to cooperate with the federal government and with each other. Furthermore, laws passed and policies made at the federal level in the U.S. require a cooperative Congress.

While Amtrak currently operates across state boundaries, and federal prerogative over interstate commerce sets precedent for governing activities such as HSR operations, compared to other countries, there is no readily available framework in the U.S. within which to address issues of HSR funding, implementation and governance.

However, models to look to for creating high-speed rail authorities and other HSR governance structures could include Eurostar and Thalys International, both of which are consortia of national rail companies that were formed to coordinate cross-border HSR service between sovereign entities (in this case, European countries), much like U.S. states would need to coordinate their HSR service.

Such arrangements will either need to be created by the national governments, or on an *ad hoc* basis, with states and regions working amongst themselves to coordinate HSR, with the help of federal funding. President Obama's recent high-speed rail program gives some viability to the former prospect. As the GAO highlighted in its report, national directives and policies will likely be needed to implement HSR in the United States.[40]

Ad hoc arrangements of states working together to build, fund and govern inter-state HSR are a possibility, assuming the states have the collective capital necessary to secure financing and the collective will to create inter-state compacts that regulate HSR and create governance structures that serve the interests of all those involved. If state transit authorities were able to get the funding necessary, they could effectively act as the national railway companies do in the cases of Eurostar and Thalys, with stakes in the ownership and governance of the system. Arrangements like this would also not preclude the ability to receive any federal funds that are directed towards HSR. In deed, among those HSR projects that have secured funding in the U.S., a few are such inter-state arrangements. In this way, coalitions of states could overcome some of the limitations of having a less-centralized national government compared to other HSR countries.

Whatever the governance arrangement may be, it is important to note that funding for HSR systems almost always depends on external capital contributions. This is because HSR almost always requires significant financial resources, as well as the financial leverage to be able to borrow such resources. While some HSR systems are able to cover the cost of operations and maintenance from the revenue received from fares alone, the upfront capital costs, in the form of track and other physical infrastructure, are usually prohibitively expensive, without the financial assistance of government. Even the most successful private companies in Japan were initially government-owned entities that benefited from government investment in capital. Successful independent companies in Europe usually own and operate their own trains, but run those trains on track that was initially paid for by the state. Whatever form HSR governance and

ownership might take in the United States, it is likely that it will require an infusion of capital from the public sector.

Another aspect to consider with regard to the political conditions in the U.S. is the fact that, in some less densely populated areas of the country, including the western United States, the federal government owns vast tracts of land. This could make the implementation of HSR easier, if the federal government were to cooperate with states in securing the right-of-way necessary to build HSR, as opposed to having to negotiate with many private land owners and having to navigate areas that are already densely populated with people and buildings. However, this prospect depends on the willingness of federal leaders, especially the President, to work together with states to implement HSR.

Cultural Conditions

While, as noted earlier, making generalizations about cultures on a country-wide basis can be problematic, and assessing the impacts that cultural factors have had or would have on the development of HSR systems is difficult, there are certain cultural features of the United States that are notable.

In terms of the Power Distance Index, the United States ranks lower on the scale, indicating relatively less deference to authority than other countries. The implications of this are that trying to impose HSR policy in a top-down fashion might prove difficult, particularly in the current domestic political climate with resistance to greater federal spending or authority. On the other hand, if support for HSR policy comes from the bottom up, as the result of successful grass-roots and public education efforts, then the political feasibility of passing and implementing HSR policy would increase.

In terms of Individualism scores, as noted earlier, the U.S. is without peer among countries who value individualism over collectivism. This could pose a difficulty for implementing HSR on two levels. First, U.S. citizens are less likely than citizens of other countries to be amenable to collective, community and national action. Also, if HSR is viewed as collective, or public, transit, sentiment among individualistic Americans could prove negative. On the other hand, while the efforts to implement HSR would necessarily be collective, if HSR were to be viewed as a means to enable individuals to have more freedom and ability to do as they desire, public attitudes towards it could be positive. Two examples of this latter case can be seen in the development of both the interstate highway system in the 1960s and the nation-wide rail expansion during the late 1800s. Both were collective efforts to be sure, but both were and are viewed as quintessentially American endeavors because of the increased freedom they provided to individuals. The difference between positive and negative reactions would depend on how HSR development were to be perceived in relationship to American individualism.

In terms of Uncertainty Avoidance, the U.S. is relatively less risk-averse than most other HSR countries, but not particularly so overall. In contrast, China is likely to be more flexible than other HSR countries when confronted with uncertain circumstances. The implication of these things could be that China, which is embarking on a massive HSR expansion, is doing so as a result of its tolerance for the uncertainty that such an expansion might entail, while the United States might be more cautious than China in the face of utilizing, on a wide-scale basis, what is, for the U.S., an uncertain technology.

Finally, with regard to Long Term Outlook, the United States is more "short-term" in its thinking and planning compared to other countries, particularly China. Americans are more likely to favor tactical decisions that solve immediate problems and address urgent issues, rather than long-term solutions, the results of which will not be realized in the near future. If HSR is not viewed as a viable solution to a current need, Americans might avoid making the decisions necessary to implement it. On the other hand, if HSR comes to be viewed as an answer to pressing transportation problems, popular support will likely be much higher.

Economic and Geographic Conditions

In terms of their economies, countries with HSR tend to be well developed, with large GDPs overall and on a per person basis. This is likely because of the financial leverage required to fund HSR projects. Even small projects cost in the billions of dollars. However, some economies that are relatively poorer, on a per person basis, such as China and Turkey, nonetheless have the financial heft, from the overall size of their economies, to afford HSR. In this aspect, the U.S. compares favorably, with, by a significant margin, the largest economy in the world and one of the wealthiest economies in the world on a per person basis. In other words, the United States has the necessary resources. On the other hand, as a measure of how much the United States actually *does* spend on transportation infrastructure overall, instead of how many resources it *could* mobilize, the U.S. commits a significantly smaller portion of its GDP to investment in transportation infrastructure, compared to other countries.

In terms of geography, most HSR countries are relatively small, with tight clusters of urbanization and population. As mentioned above, China is the only country even close in size to the U.S. that has HSR, and in China's case, HSR is concentrated on its populous, wealthier east coast only. While this perhaps indicates that a nationwide, connected network of HSR in the U.S. is not feasible, it does not preclude the possibility of regional HSR networks, such as those currently receiving federal funds under the Obama Administration's initiative. Currently, the "rule of thumb" for determining where HSR can be cost-effective compared to air travel, cars, and other modes of transportation, is where it connects densely populated areas within a 100-600 mile range, according to experts. However, it should be noted that slower trains decrease the effective range compared to air travel and, conversely, faster trains increase it.

HSR and Passenger Rail System Features

Almost all HSR systems, particularly with regard to infrastructure, have been implemented by, or with the help of, national governments. While there is a move towards market liberalization and privatization, the up-front capital costs associated with building HSR are enormous and almost always require the financial support of the national government to begin with. In some countries, HSR service has been either privatized or turned over to independent public companies or is run by international consortia comprising state companies.

Privatizations and the breaking apart of monolithic state companies are usually done because of the losses incurred by the state-run companies and because of perceived gains in efficiency and profits from making public HSR companies more competitive or from privatization. This latter consideration has driven EU laws mandating the breaking apart of monolithic state railway companies and the

separation of those companies into independent operations and infrastructure companies. While recognizing the need for state-backing in the initial capital outlays required for HSR, EU law mandates the separation of operations and infrastructure companies in order to encourage private competition to public operators and to encourage more transparent pricing and bidding for access to track owned by public infrastructure companies.

In several cases where privatization or the breaking apart of public companies has happened, such companies become profitable in terms of operations. However, these companies have usually either been relieved of the debt associated with initial capital costs, or receive government assistance, in the form of subsidies or low-interest loans, which help them to pay off the debt.

Levels of government subsidies range from places like Japan, where three of the six railways have been fully privatized and receive no government assistance (despite bearing some of the infrastructure debts incurred by the previous national railway), to the TGV in France, and some companies in western Europe, where many routes are profitable and self-funding, to places such as Turkey, where the national railway has heavy losses and requires significant subsidies.

The common features among those companies that do not receive government assistance include serving to connect areas that are densely populated and close to each other (no more than 600 miles), and they are usually either privatized or independent government companies, with operations and infrastructure independent of each other. Companies that require subsidies are usually state-owned railways that either do not separate operations from infrastructure, or which serve areas less dense and close together, and are viewed as serving areas that private enterprise would not view as profitable. However, it is notable, again, that, with the exception of Taiwan (where a private company has used a BOT agreement and may perhaps need government assistance in the future) almost no HSR starts as a private enterprise, without subsidies or help from the government.

For some less-economically developed, specifically designated geographic areas within the EU, government assistance also comes in the form of aid from the EU Regional Development Fund. The Fund disburses money to specific geographic areas for the purpose of enhancing economic development and innovation, and for infrastructure modernization. Spain, for example, has used these funds to help finance its HSR expansion, however, it will not be receiving such funds in the future.

The most common structure for providing HSR services generally includes the following:

1. A state-backed, independent, public company and/or private companies, which have responsibility for rolling stock and operations.

2. A state-backed, independent rail infrastructure company that owns and manages track and allows both the state-backed operator, as well as other private operators (which tend to be much smaller than the state company), to purchase access to infrastructure.

3. A division of the debt incurred by the previously unified (operations and infrastructure) state railway company among the operator and infrastructure manager, perhaps with government assistance in paying debt service.

FINAL OBSERVATIONS

Looking to the future, HSR is set to expand rapidly over the next 20-30 years. Countries in North America, South America, Europe, the Middle East and throughout Asia are either currently developing or have plans for developing HSR systems. Most of this development has come within just the past 10 years. High-speed rail is undeniably a transportation trend of the future. Low emissions, comfort, convenience, and time savings over air and car travel make HSR a potentially attractive alternative, given the right conditions.[41]

Questions remaining about whether and where HSR is feasible for the United States include some of the following:

- Where, exactly, will HSR corridors be located?
- What would ridership be within those corridors?
- What federal government financing would be available in the long and short term?
- Based on the above factors, what would return-on-investment be for given corridors?
- How much subsidization would be needed to finance them?
- Would the federal government or coalitions of states be willing and able to finance these projects at the levels necessary?
- What are the political obstacles to implement and fund HSR, e.g., opposition from states, airlines, or taxpayers?
- Could these obstacles be overcome, given the right circumstances?
- What governance structures can be created, given the federal nature of the United States, that would balance states' rights with the need to create inter-state or federal regulations and secure funding for HSR projects from the federal government or coalitions of states?

One additional, important factor to consider, the full effects of which are as yet unknown, is the impact of «The Great Recession.» Many countries, particularly those in Europe, with ambitious plans to develop and expand HSR are now constrained by unfavorable economic conditions generally, with some countries facing untenable fiscal deficits. The austerity measures, or fiscal cuts, required to combat these deficits, as well as meet the demands of creditors, could imperil some of these plans in both the short and medium terms. Spain, for instance, which, relative to its size and population, has one of the most ambitious HSR plans in the world, is now confronted with creditors who demand higher interests rates on loans for what they perceive as Spain's increased risk of sovereign debt default. Spain and other countries in similar circumstances could find themselves unable to finance their infrastructure investments, including in HSR.

On the other hand, emerging economies, such as China, have weathered the recession better than most developing countries and are still investing massive sums in building and upgrading the infrastructure they need to support their rapidly developing and expanding economies. China has even begun to become a leader in HSR technology, recently offering its services to California, which is contemplating its own HSR project, connecting Sacramento to

Los Angeles, via several other major cities. The future history of high-speed rail in the United States has yet to be written and will depend on whether it is embraced as an efficient alternative form of transportation that deserves a place in our national infrastructure.

ENDNOTES

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