

Financial Impacts of and Financing Methods for High-Speed Rail in Portugal

By

Teng Huang

Bachelor of Engineering, Tsinghua University, 2009

Submitted to the Department of Civil & Environmental Engineering, School of Engineering, in partial fulfillment of the requirements for the degree of

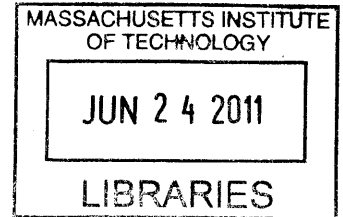
Master of Science in Transportation

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 2011

© 2011 Massachusetts Institute of Technology. All Rights Reserved.



ARCHIVES

Signature of Author.....

Department of Civil & Environmental Engineering

May 19, 2011

Certified by

Joseph M. Sussman

JR East Professor of Civil and Environmental Engineering and Engineering Systems

Thesis Supervisor

Accepted by

Heidi M. Nepf

Chair, Departmental Committee for Graduate Students

Financial Impacts of and Financing Methods for High-Speed Rail Building in Portugal

By

Teng Huang

Submitted to the Department of Civil & Environmental Engineering on May 19, 2011, in partial fulfillment of the requirements for the degree of Master of Science in Transportation

Abstract

High-speed rail (HSR) becomes a very hot topic recently when all Portugal, the United States, China, Japan, Spain, etc. are ambitious in building their HSR systems. Although HSR is expected to shrink the temporal distance between cities, reshape the travel patterns of people toward environment friendly ones, create an image effect for the country building it, promote regional economics, etc., HSR is more capital intensive than other transportation projects in both unit cost (the cost per lane km) and total cost. Due to its high costs and public or private budget constraints, HSR may have significant financial impacts on other transportation investments. And it is important to lower the costs of HSR building and explore more funding opportunities to make HSR investments more financially viable.

This research aims to understand the financial impacts of HSR investments and to explore financing methods for them. Firstly, this research examines the crowding out effect of HSR investments on other transportation investments—whether financing HSR makes the funds for other transportation projects less available due to public or private budget constraints. In addition, this research compares HSR financing with the financing of other transportation projects to figure out the uniqueness of HSR financing. Finally, this research explores innovative financing methods and identifies megaregion revenues to make HSR investments more financially viable.

We find that HSR investments crowd out other transportation investments based on the worldwide experience. In the end, we propose the use of monoline wrapped bonds and the establishment of Portuguese infrastructure bank to lower the financial costs of Portuguese HSR investments. And we recommend the use of value capture mechanisms to capture the megaregion economic benefits of HSR and gain additional revenues for Portuguese HSR investments.

Thesis Supervisor: Joseph M. Sussman

Title: JR East Professor, Civil & Environmental Engineering and Engineering Systems

Acknowledgements

First and foremost, I would like to express my sincere thanks to my supervisor Professor Joseph Sussman for his continuous support and invaluable intelligent guidance these two years. I have been benefited significantly from your immense knowledge, enthusiasm, inspiration and patience. Throughout the writing of my thesis, you provided me sound advices, lots of new ideas, and you even helped me with my writing. I could not imagine a better research supervisor and mentor than you.

I would also like to thank Travis Dunn, my friend and former lab mate. Your insightful opinions, support, and feedback help me significantly in my two year's study.

I am indebted to many of my colleagues and friends who support me a lot, in both the past and present, in the Department of Civil and Environmental Engineering and in the MIT-Portugal Program: Ryusuke Sakamoto, Henning Colsman-Freyberger, Rui Emanuel Figueiredo dos Santos, Antonio Ramos Andrade, Sevara Melibaeva, Christopher Grillo, etc. You guys help me become a better man.

Last but not least, I would like to thank my family: my father Zhiyong Huang and my mother Xiaohui Zhou for giving birth to me and for supporting and loving me all the time. Who could imagine your son sitting in the office of Massachusetts Institute of Technology ten years ago? I cannot do it without you.

Table of Contents

List of Abbreviations	13
List of Definitions	14
List of Figures	15
List of Tables	18
1. Introduction.....	21
1.1. Overview of High-Speed Rail.....	21
1.2. High-Speed Rail in Europe	22
1.3. Motivation for High-Speed Rail Investment in Portugal	23
1.4. Cost characteristics of High-Speed Rail Investment.....	25
1.5. Current Economic Condition of Portugal and Assumptions of this Thesis	26
1.6. Thesis Outline	29
2. Crowding Out Effect of HSR Investment	30
2.1. Overview.....	30
2.2. China.....	31
2.2.1. Overview of China’s Transportation Investment.....	31
2.2.2. Investments of Different Transportation Modes in China	31
2.2.3. Crowding Out Effect of HSR Investments in China.....	40
2.3. Germany.....	42
2.3.1. Overview of Germany’s Transportation Investment.....	42
2.3.2. The Federal Transport Infrastructure Plan 2003	42
2.3.3. Planning of HSR Investment in Germany.....	43
2.3.4. Crowding Out Effect of HSR Investments in Germany.....	44

2.4. Taiwan.....	45
2.4.1. HSR Investment in Taiwan.....	45
2.4.2. The New Ten Major Construction Projects	45
2.4.3. Crowding Out Effect of HSR Investments in Taiwan	46
2.5. Japan	47
2.5.1. Overview of Japan’s Transportation Investment	47
2.5.2. Crowding Out Effect of HSR Investments in Japan	51
2.6. Conclusion	52
3. Difference between Financing HSR and Other Transportation Projects	54
3.1 Overview.....	54
3.2 China.....	54
3.2.1. Overview of China’s Funding Sources for Transportation Projects	54
3.2.2. Railway System of China.....	54
3.2.3. Road and Inland Waterway System in China	60
3.2.4. Aviation Industry in China.....	63
3.2.5. Difference between Financing HSR and Other Transportation Projects in China.....	65
3.3 Germany.....	67
3.3.1. Overview of Germany’s Funding Sources for Transportation Projects.....	67
3.3.2. Road System in Germany	67
3.3.3. Railway System in Germany.....	67
3.3.4. Inland Waterways and Airports in Germany	68
3.3.5. Stuttgart Ulm Rail Project (HSR Project)	69
3.3.6. Difference between Financing HSR and Other Transportation Projects in Germany.....	72

3.4 Taiwan.....	74
3.4.1. Taiwan HSR Financing.....	74
3.4.2. The i-Taiwan 12 project.....	76
3.4.3. Difference between Financing HSR and financing other transportation projects in Taiwan....	77
3.5 Portugal.....	78
3.5.1. Overview of Portugal’s Funding Sources for Transportation Projects	78
3.5.2. Road System in Portugal.....	79
3.5.3. The Poceirao-Caia High-Speed Rail.....	81
3.5.4. Difference between financing HSR and other transportation projects in Portugal	83
3.6 Japan	84
3.6.1. Overview of Japan’s Transportation Investment	84
3.6.2. Road System in Japan	85
3.6.3. Railway System in Japan	85
3.6.4. Civil Aviation System in Japan.....	89
3.6.5. Difference between Financing HSR and Other Transportation Projects in Japan	90
3.7 Conclusion	93
4. Innovative Methods of Financing HSR	96
4.1. Overview.....	96
4.2. Bond Financing for PPP Projects.....	101
4.2.1. Bond Financing History	101
4.2.2. Key Bond Buyers and Bond Rating.....	102
4.2.3. Monolines and Wrapped Bonds.....	103
4.3. PPP Project Rating.....	104

4.3.1. Rating of PPP Projects in the Construction Phase	104
4.3.2. Rating of PPP Projects in the Operation Phase (Availability Payments).....	107
4.3.3. Rating of PPP Projects in the Operation Phase (with Exposure to Commercial Revenue Risk)	110
4.3.4. Influence of Public Capital Contribution in PPP Project Rating	111
4.3.5. Conclusion of PPP Project Rating	114
4.4. Wrapped Bond and Unwrapped Bond	115
4.4.1. History of Monoline Wrapped Bonds.....	115
4.4.2. Wrapped Bonds and Unwrapped Bonds	116
4.5. Bank Loan & Bond Market for PPP Projects.....	117
4.6. Wrapped Bonds after the Financial Crisis	120
4.7. Development of the Portuguese Pension Fund Market.....	122
4.7.1. Current Portuguese Pension Fund and Insurance Market	122
4.7.2. Social Security System Reform	123
4.7.3. Investments of Portuguese Pension Funds.....	124
4.7.4. Conclusion of Portuguese Pension Fund Market.....	124
4.8. Institutional Structure Implication	125
4.8.1. European Investment Bank	126
4.8.2. The US Infrastructure Bank (Proposed).....	127
4.8.3. Comparison of European Investment Bank and the Proposed US Infrastructure Bank.....	128
4.8.4. Conclusion of Institutional Structure Implication.....	129
4.9. Other Innovative Financing Methods: Stock IPO, Co-lending, etc.	131
4.9.1. Stock IPO.....	131
4.9.2. Co-lending.....	131

4.10. Conclusion	132
5. Megaregions and HSR Financing	133
5.1. Overview.....	133
5.2. Megaregions.....	134
5.2.1. Definition for Megaregions.....	134
5.2.2. Megaregion Governance and Planning	135
5.2.3. Megaregion and Transportation Project Investments.....	136
5.3. HSR and Megaregion formation	137
5.3.1. Overview of HSR and Megaregion Formation	137
5.3.2. The Japanese Shinkansen and the Formation of Megaregions	138
5.3.3. The French TGV and the Formation of Megaregions.....	141
5.3.4. The German ICE and the Formation of Megaregions.....	142
5.3.5. The Lisbon-Porto HSR and the Potential Formation of Lisbon-Porto Megaregions	145
5.4. HSR’s Economic Influence on Megaregions.....	147
5.4.1. Overview of HSR’s Economic Influence on Megaregions.....	147
5.4.2. The Japanese Shinkansen’s Economic Influence on Megaregions	148
5.4.3. The French TGV’s Economic Influence on Megaregions	149
5.4.4. The German ICE’s Economic Influence on Megaregions	150
5.4.5. Conclusion of HSR’s Economic Influence on Megaregions	150
5.5. Megaregion revenues and HSR financing	150
5.5.1. Introduction to Megaregion Revenues and HSR Financing.....	150
5.5.2. Value Capture Mechanisms Based on HSR’s Direct Economic Influence.....	151
5.5.3. Tax Increment Financing	152

5.5.4. Business Improvement District (BID)/Special Assessment (SA).....	154
5.5.5. Business Rate Levy.....	157
5.5.6. Land Value Tax.....	157
5.5.7. Development Impact Tax.....	160
5.5.8. Employer Tax (Versement Transport).....	161
5.5.9. Land Lease.....	162
5.5.10. Direct Development.....	163
5.5.11. Consumption Tax/Income Tax.....	167
5.5.12. Portugal’s Current Tax System Related to Value Capture.....	168
5.5.13. Value Capture for the Portuguese HSR Building.....	169
5.6. Conclusion.....	172
6. Conclusion and Suggestions for HSR Financing in Portugal.....	173
6.1. Summary of Findings and Recommendations.....	173
6.2. Future Work.....	176
6.3. A Closing Word.....	177
References.....	178
Appendix A: Current Events of Relevance.....	189
Portugal.....	189
China.....	190
Japan.....	190
The United States.....	191

List of Abbreviations

BID	Business Development District
CA	Concession Agreement in Public Private Partnerships
DBA	Design-Build Agreement in Public Private Partnerships
EIB	The European Investment Bank
EU	The European Union
GDP	Gross Domestic Product
HSR	High Speed Rail
IA	Insurance Asset
IMI	Annual Property Tax (Imposto Municipal Sobre Imóveis)
IMF	International Monetary Fund
IMT	Property Purchase Tax (Imposto Municipal)
JR East	East Japan Railway Company
LGTT	Loan Guarantee Instrument for TEN Transport
OECD	Organization for Economic Cooperation and Development
PFA	Pension Fund asset
PFI	Private Finance Initiative
PPP	Public Private Partnerships
SA	Special Assessment
SAD	Special Assessment District
TEN-T	Trans-European Networks of Transport
TIF	Tax Increment Financing
VAT	Value-added Tax

List of Definitions

Ad valorem taxes	An ad valorem tax (Latin for according to value) is a tax based on the value of real estate or personal property. The foundation principles for ad valorem taxes are that each property is valued according to its market value (equity) and that each property is taxed based upon a single millage rate that applies to everyone (uniformity).
Asset based security	A security whose value and income payments are derived from and collateralized (or "backed") by a specified pool of underlying assets.
Asset based securization	The process of issuing asset based securities
Availability payment	A periodic payment made to a concessionaire by a public authority for providing an available facility
Credit Default Swap	A credit default swap (CDS) is essentially an insurance contract. The buyer of CDS pays an annual yield to the seller of CDS in exchange for loss compensation when the reference obligation defaults. This annual yield refers to the price of CDS. The higher the yield, the higher the expected loss of default is.
Direct Tax	A tax paid directly to the government by the persons on whom it is imposed
Fitch's Rating	From excellent to poor: AAA, AA+, AA, AA-, A+, A, A-, BBB+, BBB, BBB-, BB+, BB, BB-, B+, B, B-, CCC+, CCC, CCC-, CC, C, D. Ratings above BBB- are investment grade
Force Majeure	An extraordinary event or circumstance beyond the control of the parties, such as a war, strike, riot, crime, or an event described by the legal term "act of God" (such as flooding, earthquake, or volcanic eruption)
Indirect tax	A tax not paid directly to the government by the persons on whom it is imposed
Monoline Company	Companies whose sole line of business is to provide bond insurance services to one industry are called monoline insurers. The term 'monoline' eventually became synonymous in some literature with terms like 'financial guarantors'.
Moody's Rating	From excellent to poor: Aaa, Aa1, Aa2, Aa3, A1, A2, A3, Baa1, Baa2, Baa3, Ba1, Ba2, Ba3, B1, B2, B3, Caa1, Caa2, Caa3, Ca, C. Ratings above Baa3 are investment grade.
Negative carry	The carry of an asset is the return obtained from holding it (if positive), or the cost of holding it (if negative)
Non-recourse loan	A secured loan (debt) that is secured by a pledge of collateral, typically real property, but for which the borrower is not personally liable.
Real Toll	A payment made direct from people using the roads to the PPP project company
Shadow Toll	A payment made by government to the PPP project company, at least in part, on the number of vehicles using the road.
Stock IPO	Initial public offering of stocks
Swap	A derivative in which counterparties exchange certain benefits of one party's financial instrument for those of the other party's financial instrument.
Traditional procurement method	The method that the governments will normally commission consultants to prepare designs and specifications for works that are then constructed by a contractor engaged separately. This item is used against PPP.
Unwrapped bond	The PPP project bond not insured by monolines.
Wrapped bond	The PPP project bond fully insured by monolines.

List of Figures

Figure 1-1 Planned High-Speed Rail Investments in Portugal	23
Figure 1-2 Cost Comparison of HSR and Toll Roads.....	25
Figure 2-1 Fixed Asset Investment in Different Transportation Modes (US\$ billions)	32
Figure 2-2 Increase of Fixed Asset Investment of Different Transportation Modes Based on Their 2004 Value.....	33
Figure 2-3 Fixed Asset Investment in Different Transportation Modes / The Total Fixed Asset Investment of The Society.....	34
Figure 2-4 Increase of Ratio of Fixed Asset Investment of Different Transportation Modes / The Total Fixed Asset Investment of the Society Based on Their 2004 Value.....	34
Figure 2-5 Fixed Asset Investment of Different Transportation Modes / The Total Fixed Asset Investment in Transportation.....	35
Figure 2-6 Increase of Ratio of Fixed Asset Investment of Different Transportation Modes / The Total Fixed Asset Investment in Transportation Based on Their 2004 Value	36
Figure 2-7 Annual Fixed Asset Investment of the Transportation Industry and the Whole Society	37
Figure 2-8 The Percentage of The Annual Transportation Fixed Asset Investment in the Annual Total Fixed Asset Investment of the Whole Society	38
Figure 2-9 Accumulated Fixed Asset Investment of the Transportation Industry and the Whole Society.	39
Figure 2-10 The Percentage of Accumulated Transportation Fixed Asset Investment in the Accumulated Total Fixed Asset Investment of the Whole Society (Starting From 2004).....	39
Figure 2-11 The Increase of Fixed Asset Investment of Different Transportation Modes Based on Their 2008 Value (Japan)	49
Figure 2-12 The Increase of Ratio of Fixed Asset Investment of Different Transportation Mode / The Total Fixed Asset Investment of The Society Based on Their 2008 Value (Japan)	50
Figure 3-1 The Planned Passenger-Dedicated HSR Line Network in China.....	56
Figure 3-2 Funding Structure of Beijing-Shanghai HSR.....	59
Figure 3-3 Funding Structure of German Railway System.....	68
Figure 3-4 Stuttgart 21 Project.....	70

Figure 3-5 Funding Structure of Stuttgart 21	71
Figure 3-6 Funding Structure of Wendlingen-Ulm HSR Line.....	72
Figure 3-7 Projected Funding Structure of THSR	75
Figure 3-8 Actual Funding Structure of THSR.....	76
Figure 3-9 Funding Structure of Beiras Litoral / Alta Shadow Toll Road.....	81
Figure 3-10 Map of the Poceirao-Caia High-Speed Rail	82
Figure 3-11 Funding Structure of the Poceirao-Caia HSR	82
Figure 3-12 Takasaki-Karuizawa HSR Financing	87
Figure 3-13 Tukuba New Express Financing	89
Figure 3-14 Chūbu Centrair International Airport Financing	90
Figure 4-1 Operating Revenue VS. Total Financial Cost of THSR.....	98
Figure 4-2 % of Financial Cost Relative to Operating Revenue of Taiwan HSR.....	99
Figure 4-3 Difference between Traditional Government Procurement Methods and PPP in Portuguese HSR Projects.....	100
Figure 4-4 Typical PPP Design-Build Structure.....	105
Figure 4-5 Factors Used by Moody for PPP Project’s Rating in the Operation Phase	108
Figure 4-6 Example Used to Illustrate the Influence of Public Capital Contributions	113
Figure 4-7 Example Used to Illustrate the Influence of Public Capital Contributions	113
Figure 4-8 Pension Fund Market in Portugal.....	123
Figure 5-1 Relationship between Innovative Financing Methods and Financially Viable Projects	133
Figure 5-2 Map of the Japanese Shinkansen Network in 2010.....	139
Figure 5-3 Time Space Chart from/to Tokyo by Mode	140
Figure 5-4 Map of the French TGV Network in 2010.....	141
Figure 5-5 Time Space Chart from/to Paris by Mode.....	142

Figure 5-6 Map of the German ICE Network in 2010.....	143
Figure 5-7 Time Space Chart from/to Frankfurt by Mode.....	144
Figure 5-8 The Lisbon-Porto HSR in Portugal	145
Figure 5-9 Time Space Chart from/to Lisbon by Mode.....	146
Figure 5-10 TIF in the North Side of the Chicago City	153
Figure 5-11 Business Improvement District in San Diego	156
Figure 5-12 Theory of Land Value Tax.....	158
Figure 5-13 Map of Australia.....	159
Figure 5-14 Components of JR East's Non-Transportation Operating Revenue	165
Figure 5-15 Transportation VS. Non-Transportation Operating Revenue.....	165

List of Tables

Table 2-1 Fixed Asset Investment in Different Transportation Modes (US\$ billions).....	32
Table 2-2 Increase of Fixed Asset Investment of Different Transportation Modes Based on Their 2004 Value.....	32
Table 2-3 Fixed Asset Investment in Different Transportation Modes / The Total Fixed Asset Investment of the Society	33
Table 2-4 Increase of Ratio of Fixed Asset Investment of Different Transportation Modes / The Total Fixed Asset Investment of the Society Based on Their 2004 Value.....	34
Table 2-5 Fixed Asset Investment of Different Transportation Modes / The Total Fixed Asset Investment in Transportation.....	35
Table 2-6 Increase of Ratio of Fixed Asset Investment of Different Transportation Mode / The Total Fixed Asset Investment in Transportation Based on Their 2004 Value	36
Table 2-7 Annual Fixed Asset Investment of the Transportation Industry and the Whole Society.....	37
Table 2-8 Accumulated Fixed Asset Investment of the Transportation Industry and the Whole Society ..	38
Table 2-9 Crowding Out Effect---China	41
Table 2-10 Crowding Out Effect---Germany.....	44
Table 2-11 Crowding Out Effect---Taiwan	47
Table 2-12 Fixed Asset Investment in Different Transportation Modes (Japan), Billion USD.....	48
Table 2-13 The Increase of Fixed Asset Investment of Different Transportation Modes Based on Their 2008 Value (Japan)	48
Table 2-14 Fixed Asset Investment of Different Transportation Mode / Total Fixed Asset Investment in Transportation (Japan)	49
Table 2-15 The Increase of Ratio of Fixed Asset Investment of Different Transportation Modes / The Total Fixed Asset Investment of the Society Based on Their 2008 Value (Japan).....	50
Table 2-16 Crowding Out Effect---Japan	52
Table 2-17 Crowding Out Effect Summary	52
Table 3-1 Chinese Open-Service HSR Lines with the Designed Speed of 250km/h	57

Table 3-2 Chinese Open-Service HSR Lines with the Designed Speed of 350km/h	57
Table 3-3 Investment in Roads, Waterways and Sea Ports (China)	60
Table 3-4 Financing Activity of Ganyue Expressway Company.....	63
Table 3-5 Difference In Financing---China	66
Table 3-6 Difference in Financing---Germany	73
Table 3-7 Funding Structure of Transportation Projects in i-Taiwan 12 Projects	77
Table 3-8 Difference in Financing---Taiwan	78
Table 3-9 Funding Structure of the Beiras Litoral / Alta Shadow Toll Road	80
Table 3-10 Difference in Financing---Portugal.....	84
Table 3-11 The Tukuba New Express Financing.....	88
Table 3-12 The Chūbu Centrair International Airport Financing	90
Table 3-13 Difference in Financing----Japan.....	92
Table 3-14 Comparison of HSR System in Different Countries.....	93
Table 3-15 Comparison of HSR Financing in Different Countries	94
Table 4-1 Income Statement of Taiwan HSR	98
Table 4-2 Important Components of Moody's Rating Model of PPP Projects in the Construction Phase	107
Table 4-3 Important Components of Moody's Rating Model of PPP Projects in the Operation Phase	110
Table 4-4 Pros and cons of Both Bank Loans and Wrapped Bonds Can be Summarized As follows.....	119
Table 4-5 Rating Change of Monoline Companies during the Financial Crisis	120
Table 5-1 Development Zones in Response to the Connection to HSR Networks.....	148
Table 5-2 The Employment Growth Rates of Information Exchange Industries (1981-1985).....	149
Table 5-3 Components of JR East's Operating Revenue	164
Table 5-4 IMI Tax Rate for Permanent Residences.....	169

Table 5-5 IMI Tax Rate for Non-Permanent Residences.....	169
Table 5-6 Characteristics of Different Value Capture Mechanisms (I)	170
Table 5-7 Characteristics of Different Value Capture Mechanisms (II).....	171

1. Introduction

1.1. Overview of High-Speed Rail

There is no authoritative or standard definition for High-Speed Rail (HSR). The European Union (EU) defines HSR lines as new lines to be “designed for speeds above 250 km/h” and upgraded lines to be designed “for speeds up to 200 or even 220 km/h”. (International Union of Railway, 2011) HSR is best suited for journeys ranging from 250 to 900 km: if the distance is larger than 900 km, the air transportation becomes more attractive because of its time saving advantage in long distance, and it typically dominates the whole market; if the distance is smaller than 250 km, HSR typically doesn't have competitive advantages compared with cars. (Naukowy, 2010)

There are four methods to improve the conventional railway systems: the first one is to upgrade existing railways, and use existing trains to achieve higher speed; the second one is to upgrade existing railways and use dedicated High-Speed Trains; the third one is to build new dedicated HSR lines and use dedicated High-Speed Trains; the fourth one is to combine the first and second methods. Although designed speed is increased and service quality is enhanced from method one to method three, construction costs and financing pressure also increase from method one to method three. Sometimes the method three is too expensive that people may have to turn to other cheaper options, for example, the California government may finally choose to upgrade existing railway lines instead of building dedicated HSR lines between San Francisco and San Jose due to the budget constraint. More details of this California HSR issue are illustrated in Appendix A. It should also be noted that the HSR defined by the EU refers to the railway lines built using method two and three.

Japan, France, and Germany were the pioneers for the deployment of HSR. The first HSR trains of these three countries, namely the Japanese Shinkansen, the French TGV, and the German Intercity Express, finished the first trips in 1964, 1981 and 1991. (Sands, 1993) Following Japan, France and Germany, South Korea and Taiwan were in the second wave of HSR deployment. The first HSR trains of these two countries, namely Korea Train Express and Taiwan High Speed Rail, finished the first trips in 2004 and 2007. (Loubinoux, 2008; Taiwan High-Speed Rail, 2011) High-Speed Rail has become one of the most important transportation modes in the world. For example, China has 8,358 km HSR in operation up to January, 2011 (Bi, 2011); Japan has 2452 km HSR in operation, and 590 km under construction; France has 1871 km HSR in operation, and 299 km under construction; Spain has 1598 km HSR in operation,

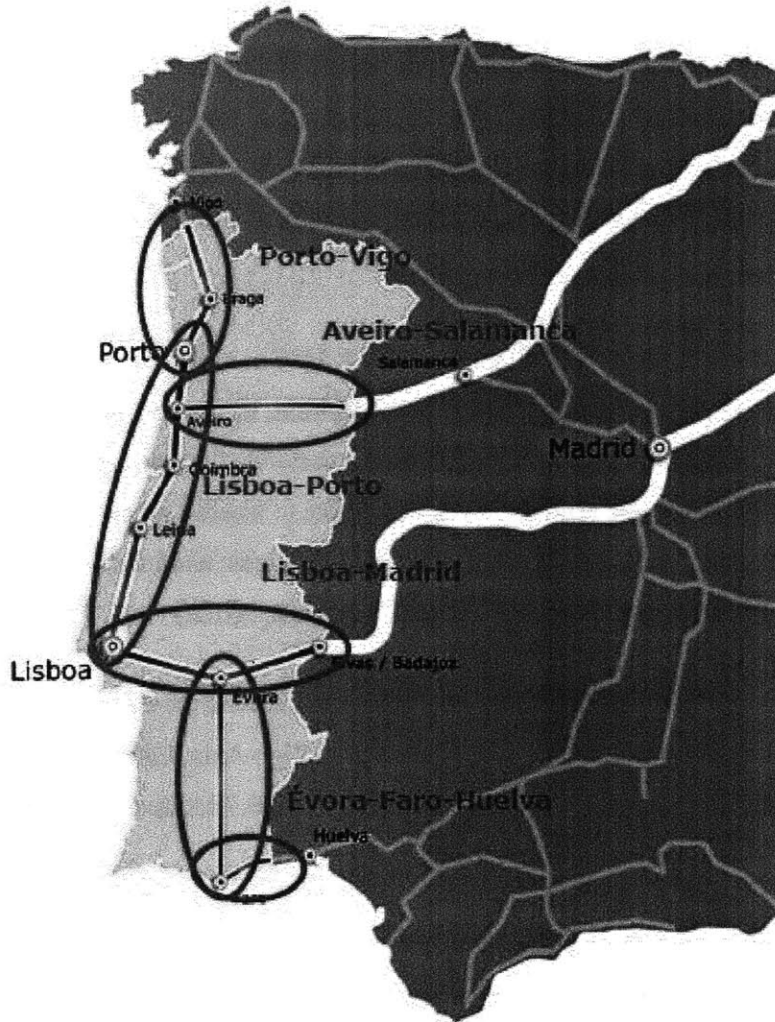
and 2219 km under construction; and Germany has 1285 km HSR in operation, and 378 km under construction. (Department of Transport (the UK), 2010)

1.2. High-Speed Rail in Europe

High-Speed Rail has been used by the EU to promote the integration of Europe. The EU is “developing the most efficient and integrated High-Speed Rail network of the world and it is promoting a rail corridor with preference for freight.” The total length of the Trans-European Transport Network (TEN-T) is “30,000 km, out of which 20, 000 km are expected to be in operation by the year 2020.” (European Commission, 2011)

Portugal is also very ambitious in its High-Speed Rail system. It plans to invest in five HSR lines, as parts of the TEN-T network in Europe in the future: Lisbon-Madrid (2013), Lisbon-Oporto (2015), Oporto-Vigo (2013), Aveiro-Salamanca, and Évora–Faro-Huelva. (RAVE, 2008) The map of the planned Portuguese HSR is illustrated in Figure 1-1. Portugal has finished financing the Poceirao-Caia HSR project, its first HSR project and part of the Lisbon-Madrid HSR line. (RAVE, 2010B) Within these planned HSR lines, the Lisbon-Madrid and Aveiro-Salamanca lines, or the East-West lines, are supposed to link Portugal to Spain, while the others are planned to serve the economic development of Portugal itself.

Figure 1-1 Planned High-Speed Rail Investments in Portugal



Source: RAVE.2008. The Portuguese High-Speed Rail Project: General Overview and Status of the Project. RAVE's Presentation. Lisbon, Portugal. September, 2008.

1.3. Motivation for High-Speed Rail Investment in Portugal

According to Melibaeva, Sussman, and Dunn (2010), HSR is becoming more important and popular in the world because “roads and airports become more congested and greenhouse gas levels increase.” They expect HSR to “reshape the travel patterns and activities of people and consequently changing the ways cities develop.” Based on their analyses, capacity increase of transportation infrastructure, provision of an

environment friendly transportation alternative, and promotion of regional economic development are all important motivations for HSR investments. (Melibaeva, Sussman, and Dunn, 2010)

In addition, the building of HSR may also create an image effect and help promote the reputation of a country. According to Sands (1993), the Japanese Shinkansen “has also had an image effect, further strengthening the image of Japan as a nation of precision and reliability, not just one of cherry blossoms”. (Sands, 1993) In addition, after the earthquake and tsunami crisis on March 11th, 2011, the reopening of the Shinkansen service from Tokyo to Sendai on April 25th, 2011 may have a symbolic effect for Japanese people, increasing their confidence in the railways and the country and the government. More details are discussed in Appendix A.

The motivations for building Portuguese HSR are stated by RAVE as “enable a modern, sustainable and efficient transport system; reduce the country’s peripheral position, by connecting Portugal to Europe; contribute to the Atlantic south-west front competitiveness; accelerate the country’s economical and technological development, also at the regional level; contribute to a better modal distribution, both for passenger and freight, changing the actual hegemony of road solutions; and increase mobility and competitiveness of the port, airport and logistics systems”. (RAVE, 2010a)

Portugal uses cost benefit analysis based on demand forecast to evaluate the economic benefits generated from its HSR projects. According to RAVE (2010a), the Porto-Vigo Axis, Lisbon-Porto Axis, Lisbon-Madrid Axis are estimated to generate 1.7 million, 7.4 million, and 6.7 million HSR journeys and economic IRR of 2.4%, 10.8% and 5.9% respectively.

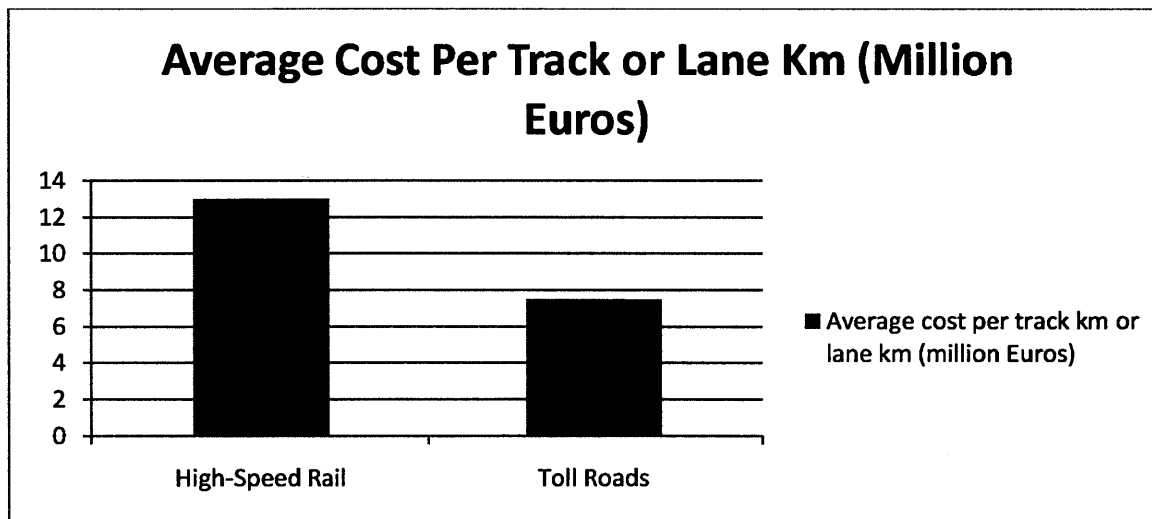
In addition, according to RAVE (2008), the building of Lisbon-Porto, Lisbon-Madrid and Porto-Vigo HSR lines can greatly promote regional economic development: 56 thousand new permanent jobs are expected to be created in the long run; the private investment of the whole society is expected to increase by 126 billion Euros; GDP is expected to increase by 121 billion Euros, approximately 50% of the estimated GDP in 2010; tax revenues are expected to achieve cumulative increase of 64 million Euros. Furthermore, the building of Portuguese HSR network is projected to bring a positive effect in all regions, promote greater social and economic cohesion between regions, and help Portugal connect more closely to other countries in Europe by integrating in the TEN-T network. (RAVE, 2008) Therefore, we can conclude that Portuguese HSR projects are mostly megaregion projects: megaregions are the regions with large agglomeration of economic activities, and HSR may contribute to the formation and economic

development of megaregions. We will discuss this megaregion concept in more detail in Chapter 5, *Megaregions and HSR Financing*.

1.4. Cost characteristics of High-Speed Rail Investment

Although HSR is expected to bring significant benefits, HSR is more capital intensive than other transportation projects in both unit cost (the cost per lane km) and total cost. As illustrated in Figure 1-2, the average unit cost of HSR infrastructure is about 13 million Euros, whereas the average unit cost of toll road infrastructure is only about 7 million Euros. In addition, the unit cost of one HSR project can vary significantly. For example, the unit cost of the Hokuriku Shinkansen in Japan, is 4 times higher than the unit cost of the Spanish High-Speed Rail line between Madrid and Lérida. (FitchRating, 2010) In addition to the infrastructure costs, rolling stock and signal and communication system can also be very expensive. For example, the budget for dedicated HSR train to operate along several Illinois corridors is as large as 262.8 million USD. (Illinois Government News Network, 2011)

Figure 1-2 Cost Comparison of HSR and Toll Roads



Source: FitchRating. 2010. High-Speed Rail Projects: Large, Varied and Complex. Retrieved March, 2011 from www.fitchratings.com

According to FitchRating (2010), the total capital costs of HSR projects usually exceed 1 billion Euros, or 1.5 billion Euros, primarily due to the long distance nature of HSR projects. Therefore, capital costs, or the costs to construct infrastructures, of HSR investments, account for a larger portion of total costs than capital costs of other transportation projects do. In Portugal, the total construction investment for the

Poceirao-Caia HSR project is about 1.359 billion Euros and the life cycle costs of this project are 1.814 billion Euros when discounting all the cash flow back to 2008. (RAVE, 2010b) The high capital costs of HSR investments can sometimes prevent people from building HSR systems. In February 2011, Florida Governor Rick Scott (R) announced that Florida was giving up the state's High-Speed Rail project linking Tampa with Orlando because the state government may still have to provide 3 billion USD even though the federal government provided 2.4 billion USD at the beginning. More details are illustrated in Appendix A. (William, 2011)

In addition, even the operation costs of HSR account for a smaller portion of total costs than the operation costs of other transportation projects do, the operating costs can also prevent people from building HSR projects. For example, both the Ohio's Governor John Kasich and the Wisconsin's Governor Scott Walker rejected the funding from the federal government of the United States to build their HSR projects due to their worry about the high operating costs. More details are discussed in Appendix A.

The cost-intensiveness characteristic of HSR investments increases people's concern that HSR investments may make the funds for other transportation modes less available due to public or private budget constraints, or in other words, HSR investments crowd out investments of other transportation modes. For example, as for the building of HSR in Spain, "Critics say the country's massive investment in High-Speed Rail has come at the expense of other, less-glamorous forms of transportation. Starved of funds, Spain's antiquated freight-train network has fallen into disuse, forcing businesses to move their goods around by road." (Catan, 2009)

1.5. Current Economic Condition of Portugal and Assumptions of this Thesis

Portugal, as a part of the EU, is considered to be a developed country in the world, with the GDP of 232.8 billion USD in 2009. (The World Bank, 2011a) The 2008 financial Crisis has severely damaged the Portuguese economy, resulting in "a wide range of domestic problems specifically related to the levels of public deficit in the economy, as well as the excessive debt levels, soaring up to at least 223% of Portugal's GDP." (The World Bank, 2011b) The Portuguese government is struggling between spending more money to stimulate the weak domestic economy and limiting its public spending to maintain its public deficit level around the EU average. It has been predicted that "the Portuguese economy will not significantly recover until 2012." (The World Bank, 2011b)

The 2010 European sovereign debt crisis, originally started in Greece, has also severely affected the economy of the EU members including Portugal, Ireland, Italy, Greece, Spain, and Belgium. The fear of this crisis can be reflected by “the widening of bond yield spreads and risk insurance on credit default swaps ¹ between these countries and other EU members, most importantly Germany.” (International Business Times, 2011, Matlock, 2010, and Oakley and Hope, 2010)

Portugal’s sovereign debt rating has been downgraded significantly recently. In March, 2011, Portugal’s sovereign debt rating was downgraded by Moody’s Investors Service, one of the three biggest rating agencies, to A3², a rating only four steps from so-called junk status. Moody explained the reasons as “a weaker outlook for economic growth, risks to the government’s deficit- reduction plans and a possible need to recapitalize banks.” (Lima and Rastello, 2011) On April 1st, 2011, Portugal’s sovereign debt rating was downgraded by Fitch Rating, another top three rating agency, to BBB-³, the lowest investment grade. (Ross-Thomas and Meier, 2011) On April 5th, 2011, Portugal’s sovereign debt rating was further downgraded by Moody’s Investors Service to Baa1, three steps from junk status. (Ross-Thomas and Meier, 2011)

On April, 6th, 2011, Portugal informed the EU of its intention to ask for “the activation of financial support mechanisms”, or financial bailout. (Froymovich, 2011) According to Minder and Castle (2011), “Europe’s monetary affairs commissioner said that preliminary estimates indicated that Portugal would need about 80 billion Euros, or \$114 billion, though some analysts have suggested that the amount could be as much as 110 billion Euros.” (Minder and Castle, 2011)

On April 8th, 2011, Eurogroup and ECOFIN Ministers issued a statement clarifying that “EU (European Financial Stabilization Mechanism) and euro-area (European Financial Stability Facility) financial support would be provided on the basis of a policy programme supported by strict conditionality and negotiated with the Portuguese authorities”. (The European Commission, the IMF and the ECB, 2011)

On May 3rd, 2011, the European Commission, the International Monetary Fund (IMF) and the European Central Bank (ECB) issued the Memorandum of Understanding on Specific Economic Policy Conditionality for Portugal. According to this MOU, Portugal will be required to endure years of

¹ The definition of credit default swap (CDS) is illustrated in the *List of Definitions*. Here the reference obligation is the sovereign bonds of EU members.

² The definition of Moody’s rating is in *List of Definition*.

³ The definition of Fitch’s rating is in *List of Definition*.

unprecedented austerity, government expenditure cut and taxes rise (or tax deductions decrease) to reduce the government deficit to “below EUR 10,068 million (equivalent to 5.9% of GDP based on current projections) in 2011, EUR 7,645 million (4.5% of GDP) in 2012 and EUR 5,224 million (3.0% of GDP) in 2013”. (The European Commission, the IMF and the ECB, 2011) For example, this MOU requires Portugal to “reduce costs in the area of education, with the aim of saving EUR 195 million by rationalizing the school network by creating school clusters; reduce costs in Stated-owned enterprises (SOEs) with the aim of saving at least EUR 515 million; reduce corporate tax deductions and special regimes, with a yield of at least EUR 150 million in 2012” and so on. (The European Commission, the IMF and the ECB, 2011)

As for Public Private Partnerships, the MOU requires Portugal to avoid any new PPP contracts, “perform an initial assessment of at least the 20 most significant PPP contracts” (probably including the Poceirao-Caia HSR project), recruit a top international accounting firm to undertake a more detailed study of PPPs, put legal and institutional structures in place to ensure no frivolous spending in the form of PPPs is undertaken in the future, and so on. (The European Commission, the IMF and the ECB, 2011) These restrictions of new PPP contracts make it impossible for Portugal to build HSR when it is accepting bailout assistance from the EU and IMF.

In summary, in this MOU, requirements for government expenditure cuts and restrictions for new PPP contracts together significantly lower the possibility of deploying new HSR investments in Portugal when Portugal still receives financial support from the EU and IMF in the near future.

Therefore, we can conclude that the current economy of Portugal is weak and instable, and it is open to considerable question for Portugal to build a new HSR line in the near future. Our analyses in this thesis are done for the future HSR financing in Portugal when the economy of Portugal has become much better. In other words, the most important assumption of this thesis is that Portugal will build other HSR lines only when the economy of Portugal has significantly recovered.

Although this thesis tries to incorporate all the up-to-date information into the analysis (e.g. we discuss Current Events of Relevance in Appendix A), this thesis cannot avoid having many limitations and uncertainties because this thesis will be finished before May, 2011 and the current economy of Portugal is instable.

1.6. Thesis Outline

Therefore, based on the assumption that Portugal will build other HSR lines only when the economy of Portugal has significantly recovered, this thesis aims to understand 1) the crowding out effect of HSR investments on other transportation projects, 2) the use of innovative financing methods to lower the financial costs and 3) the identification of megaregion revenues to make HSR investments more financially viable. If the crowding out effect exists, the use of innovative financing methods and the identification of megaregion revenues can also help counter the crowding out effect.

The thesis is divided into six chapters. Chapter 1 is this introduction; Chapter 2 examines the crowding out effect of HSR investment on other transportation investments using comparative analysis of China, Germany, Taiwan and Japan; Chapter 3 compares HSR financing with the financing of other transportation projects in China, Germany, Taiwan, Portugal, and Japan, and in the end identifies the pros and cons of financing Portuguese HSR in various ways; Chapter 4 identifies innovative financing methods that can be used to lower the financial costs of HSR investments, and provides institutional suggestions for the use of these innovative financing methods in Portugal; Chapter 5 examines the economic influence of HSR on megaregions, and captures part of these economic benefits to finance the building of Portuguese HSR projects using value capture mechanisms; Chapter 6 concludes all the findings in this thesis, and provides recommendations for building Portuguese HSR projects in the future.

2. Crowding Out Effect of HSR Investment

2.1. Overview

In this chapter, we focus on four different countries: China, Germany, Taiwan and Japan. Our purpose is to find out whether HSR investments crowd out other transportation projects.

To be clear, we define crowding out effect of financing HSR on other transportation projects as financing HSR makes the funds for other transportation projects less available due to public or private budget constraints. To accurately measure the crowding out effect, we have to compare the scenario with HSR and the imaginary scenario without HSR, but we are unlikely to get the data of the imaginary scenario here. Therefore we define the crowding out effect using three less accurate but more measurable sub-definitions: the effect that investments in other transportation modes decrease when HSR is being built, the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment of the society when HSR is being built, and the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment in transportation when HSR is being built.

If the crowding out effect exists, we need to further analyze the scale of HSR investments, the scale change of HSR investments, and the scale change of other transportation investments, to identify whether the crowding out effect is significant. This is because if the scale and the scale change of HSR investments are not large, HSR investments are not able to crowd out other transportation investments in a large extent; if the scale change of other transportation investments is not large, the influence of HSR investments on these projects is limited.

In addition, here we are most interested in the crowding out effect of HSR investments on urban transportation because without connecting HSR to urban transportation, HSR cannot bring real time saving benefits to most people, and cannot promote the regional economic development to the largest extent.

2.2. China

2.2.1. Overview of China's Transportation Investment

In China, a very high percentage of tax revenue goes to the central government. 75% of the three most important types of tax revenue: VAT, consumer tax and Enterprise income tax goes to the central government, while only 25% are left to provincial and local governments. On the other hand, the central government is responsible for building most of infrastructures across the country. In the case of transportation infrastructures, most of the funds for building the national railway system (including HSR), national road system, and national inland waterway system come from the central government. Airports construction seems to be the only exception with only about one quarter of the funds coming from the central government. For example, 22.3 billion out of 82 billion RMB (or 3.28 billion out of 12.06 billion USD⁴), which is the total aviation infrastructure investment from 2001 to 2005, comes from the central government of China (Civil Aviation Administration of China, 2008).

Within the central government, the National Development and Reform Commission has broad administrative and planning control over the Chinese economy. It is responsible for making the important decisions on how much money should be spent on each transportation mode, which projects should be built and so on. The Ministry of Transport of the People's Republic is the executing agency which is in charge of building the national road system, national inland waterway system and national sea ports. The Ministry of Railway is responsible for the building of the national railway system, including High-Speed Rail. The Civil Aviation Administration of China is responsible for the building and coordinating of national airports.

2.2.2. Investments of Different Transportation Modes in China

The statistics of National Bureau of Statistics of China below can provide us an overview of investments of different transportation modes:

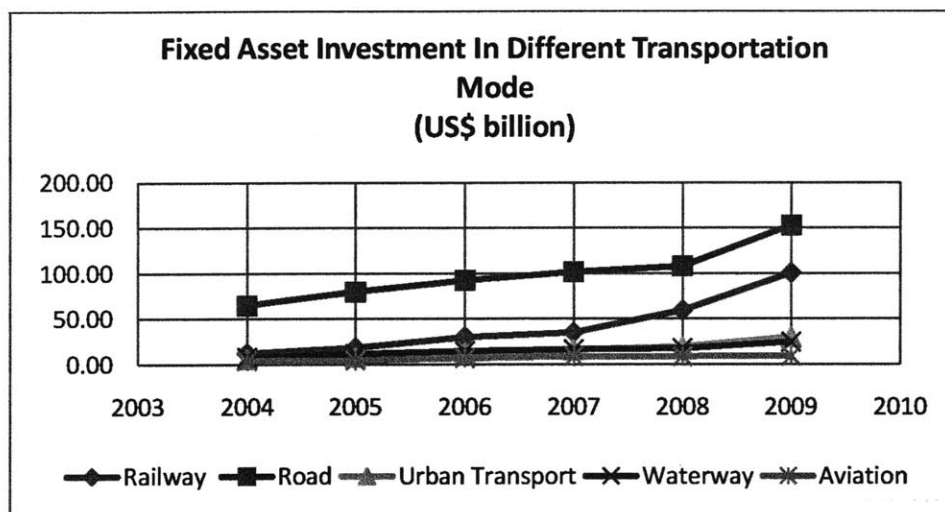
⁴ The exchange rate used here is: 1 USD=6.8 RMB

Table 2-1 Fixed Asset Investment in Different Transportation Modes (US\$ billions)⁵

Mode/Year	2004	2005	2006	2007	2008	2009
Railway ⁶	12.10	18.14	29.99	34.78	59.11	100.34
Road	64.90	79.88	92.32	101.50	107.87	152.69
Urban Transport	5.82	7.73	12.58	15.91	19.23	29.94
Waterway	7.82	11.52	14.63	16.36	17.41	24.40
Aviation	3.99	4.43	6.81	8.72	8.59	8.97

Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

Figure 2-1 Fixed Asset Investment in Different Transportation Modes (US\$ billions)



Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

Table 2-2 Increase of Fixed Asset Investment of Different Transportation Modes Based on Their 2004 Value

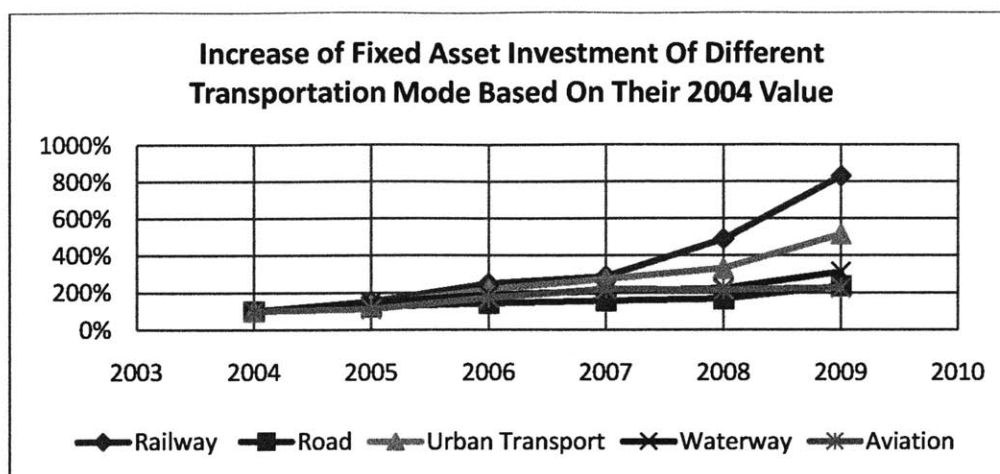
	2004	2005	2006	2007	2008	2009
Railway	100%	150%	248%	287%	489%	829%
Road	100%	123%	142%	156%	166%	235%
Urban Transport	100%	133%	216%	273%	331%	515%
Waterway	100%	147%	187%	209%	223%	312%
Aviation	100%	111%	171%	219%	216%	225%

Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

⁵ The exchange rate used here is: 1 USD=6.8 RMB

⁶ China began its HSR building in 2005 and massively increased its HSR investment in 2008

Figure 2-2 Increase of Fixed Asset Investment of Different Transportation Modes Based on Their 2004 Value



Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

From Table 2-1, Table 2-2, Figure 2-1, and Figure 2-2 above, we can see investments in all five transportation modes increased from 2003 to 2009. Investments in railway increased at the fastest pace, especially after 2007. Investments in urban transportation also increased at a very fast pace, ranking 2nd among all these five modes.

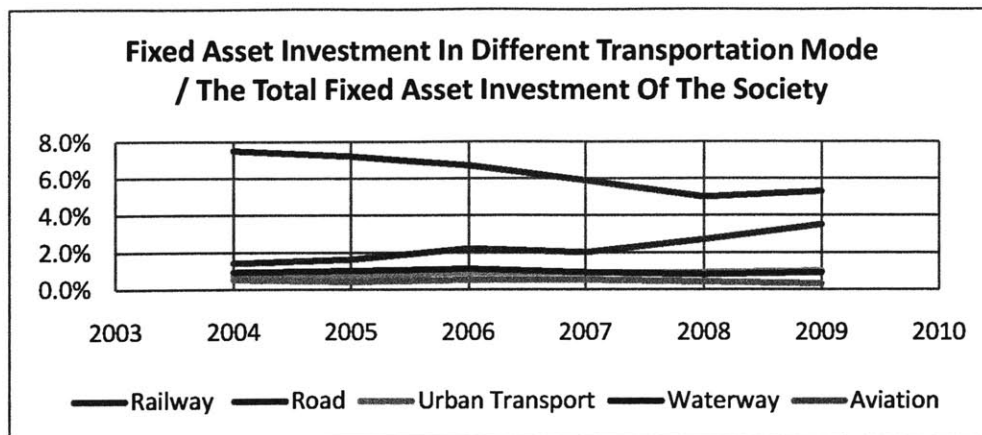
Table 2-3 Fixed Asset Investment in Different Transportation Modes / The Total Fixed Asset Investment of the Society⁷

Mode/Year	2004	2005	2006	2007	2008	2009
Railway	1.4%	1.6%	2.2%	2.0%	2.7%	3.5%
Road	7.5%	7.2%	6.7%	5.9%	5.0%	5.3%
Urban Transport	0.7%	0.7%	0.9%	0.9%	0.9%	1.0%
Waterway	0.9%	1.0%	1.1%	0.9%	0.8%	0.9%
Aviation	0.5%	0.4%	0.5%	0.5%	0.4%	0.3%

Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

⁷ The total fixed asset investment of the society includes both the public and private investments

Figure 2-3 Fixed Asset Investment in Different Transportation Modes / The Total Fixed Asset Investment of The Society



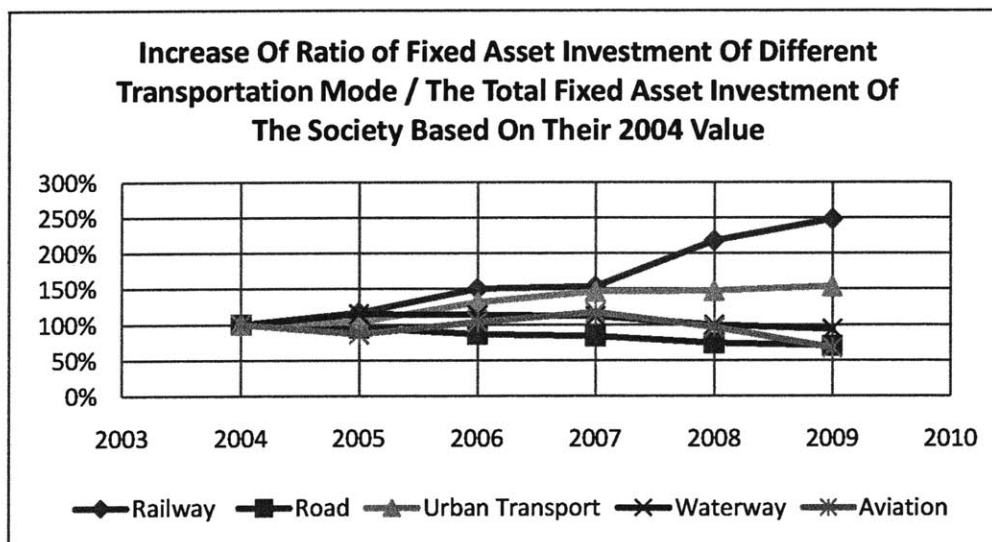
Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

Table 2-4 Increase of Ratio of Fixed Asset Investment of Different Transportation Modes / The Total Fixed Asset Investment of the Society Based on Their 2004 Value

	2004	2005	2006	2007	2008	2009
Railway	100.0%	114.3%	157.1%	142.9%	192.9%	250.0%
Road	100.0%	96.0%	89.3%	78.7%	66.7%	70.7%
Urban Transport	100.0%	100.0%	128.6%	128.6%	128.6%	142.9%
Waterway	100.0%	111.1%	122.2%	100.0%	88.9%	100.0%
Aviation	100.0%	80.0%	100.0%	100.0%	80.0%	60.0%

Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

Figure 2-4 Increase of Ratio of Fixed Asset Investment of Different Transportation Modes / The Total Fixed Asset Investment of the Society Based on Their 2004 Value



Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

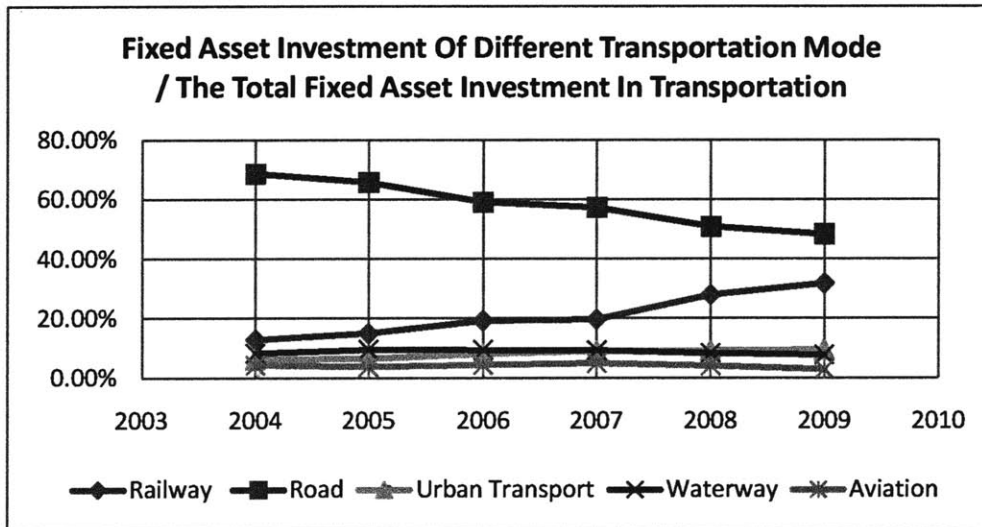
From Table 2-3, Table 2-4, Figure 2-3, and Figure 2-4 above, we can conclude the fixed asset investments in railway and urban transportation increased as a percentage of the total fixed asset investment of the society from 2003 to 2009. At the same time the fixed asset investments in road decreased as a percentage of the total fixed asset investment of the society from 2003 to 2009. The fixed asset investments in waterway stayed almost flat as a percentage of the total fixed asset investment of the society from 2003 to 2009.

Table 2-5 Fixed Asset Investment of Different Transportation Modes / The Total Fixed Asset Investment in Transportation

	2004	2005	2006	2007	2008	2009
Railway	12.79%	14.90%	19.18%	19.62%	27.85%	31.72%
Road	68.59%	65.63%	59.05%	57.26%	50.83%	48.27%
Urban Transport	6.15%	6.35%	8.05%	8.97%	9.06%	9.47%
Waterway	8.26%	9.47%	9.36%	9.23%	8.20%	7.71%
Aviation	4.21%	3.64%	4.36%	4.92%	4.05%	2.84%
Total	1	1	1	1	1	1

Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

Figure 2-5 Fixed Asset Investment of Different Transportation Modes / The Total Fixed Asset Investment in Transportation



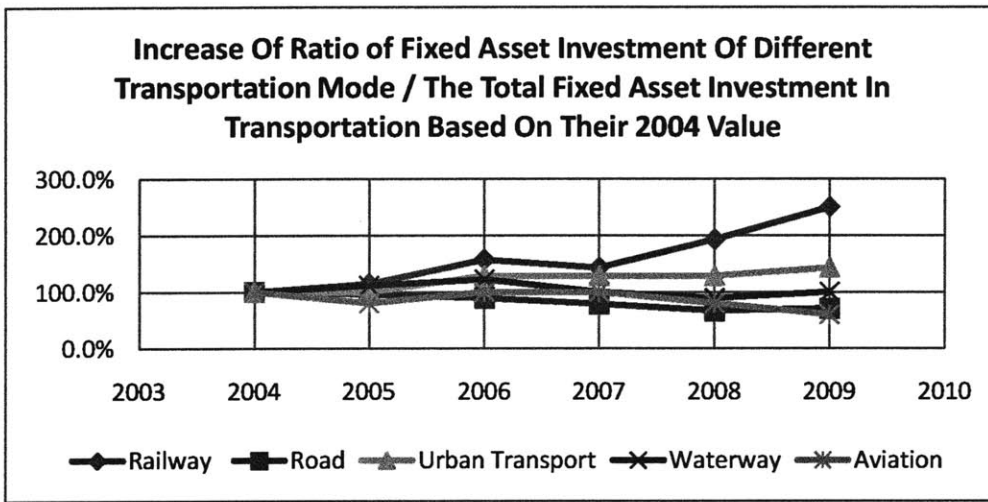
Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

Table 2-6 Increase of Ratio of Fixed Asset Investment of Different Transportation Mode / The Total Fixed Asset Investment in Transportation Based on Their 2004 Value

	2004	2005	2006	2007	2008	2009
Railway	100%	117%	150%	153%	218%	248%
Road	100%	96%	86%	83%	74%	70%
Urban Transport	100%	103%	131%	146%	147%	154%
Waterway	100%	115%	113%	112%	99%	93%
Aviation	100%	86%	103%	117%	96%	67%

Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

Figure 2-6 Increase of Ratio of Fixed Asset Investment of Different Transportation Modes / The Total Fixed Asset Investment in Transportation Based on Their 2004 Value



Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

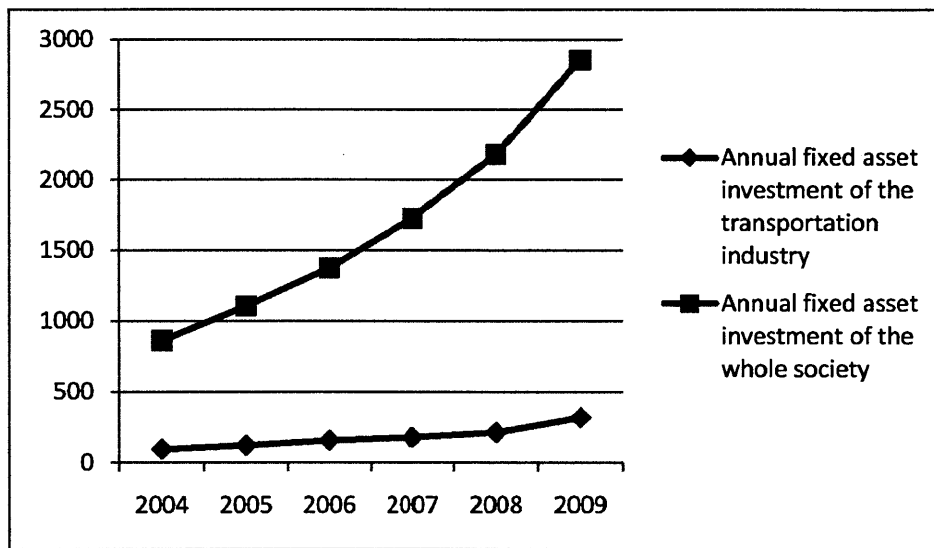
From Table 2-5, Table 2-6, Figure 2-5, and Figure 2-6 above, we can conclude the fixed asset investments in railway and urban transportation increased as a percentage of the total fixed asset investment in transportation from 2003 to 2009. At the same time the fixed asset investments in road and aviation decreased as a percentage of the total fixed asset investment in transportation increased from 2003 to 2009. The fixed asset investments in waterway stayed almost flat as a percentage of the total fixed asset investment in transportation increased from 2003 to 2009.

Table 2-7 Annual Fixed Asset Investment of the Transportation Industry and the Whole Society

	2004	2005	2006	2007	2008	2009
Annual fixed asset investment of the transportation industry	94.62	121.70	156.33	177.26	212.21	316.35
Annual fixed asset investment of the whole society	862.06	1104.36	1374.59	1726.68	2178.93	2854.98
The percentage of transportation fixed asset investment in the total fixed asset investment (annually)	10.98%	11.02%	11.37%	10.27%	9.74%	11.08%

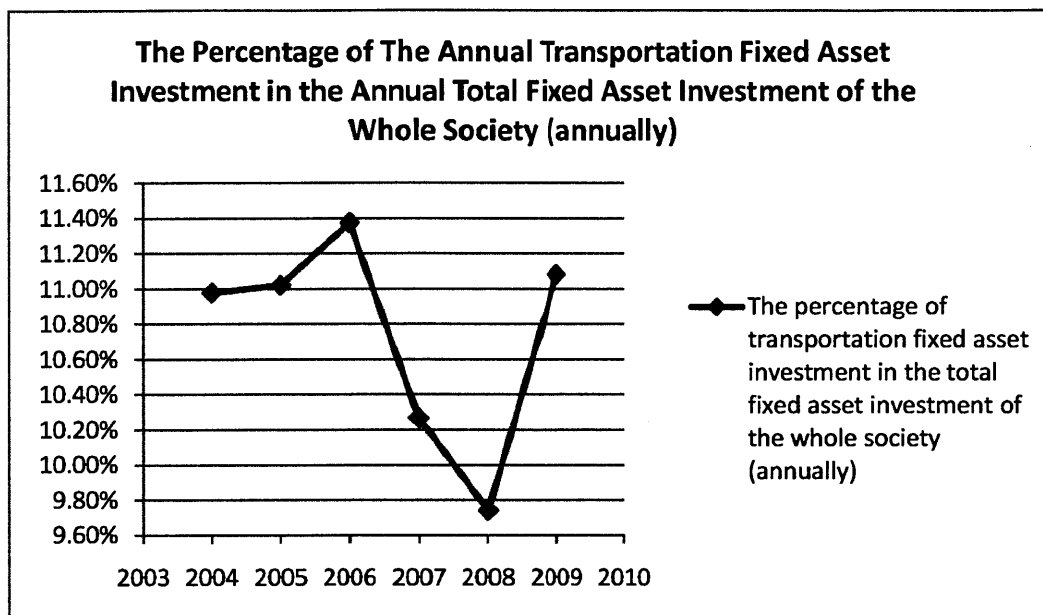
Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

Figure 2-7 Annual Fixed Asset Investment of the Transportation Industry and the Whole Society



Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

Figure 2-8 The Percentage of The Annual Transportation Fixed Asset Investment in the Annual Total Fixed Asset Investment of the Whole Society



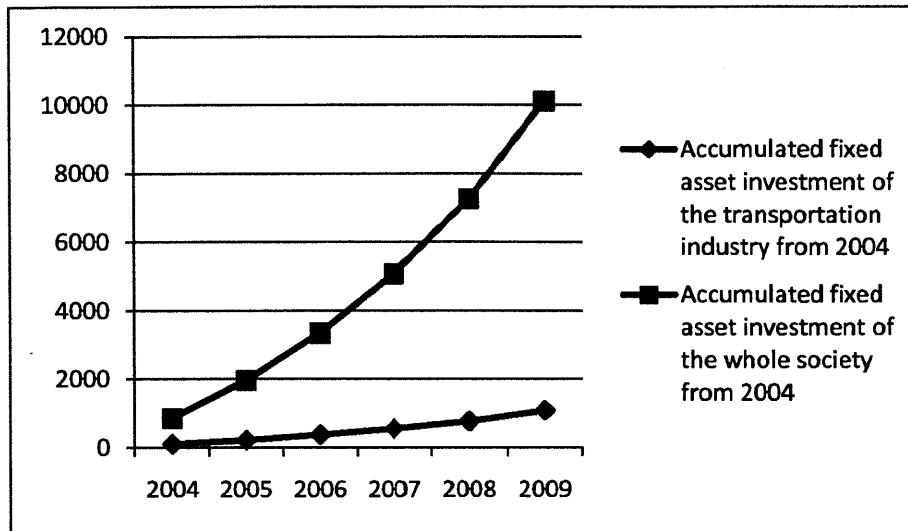
Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

Table 2-8 Accumulated Fixed Asset Investment of the Transportation Industry and the Whole Society

	2004	2004-2005	2004-2006	2004-2007	2004-2008	2004-2009
Accumulated fixed asset investment of the transportation industry from 2004	94.62	216.32	372.65	549.91	762.12	1078.46
Accumulated fixed asset investment of the whole society from 2004	862.06	1966.42	3341.02	5067.69	7246.62	10101.60
The percentage of transportation fixed asset investment in the total fixed asset investment (accumulated from 2004)	10.98%	11.00%	11.15%	10.85%	10.52%	10.68%

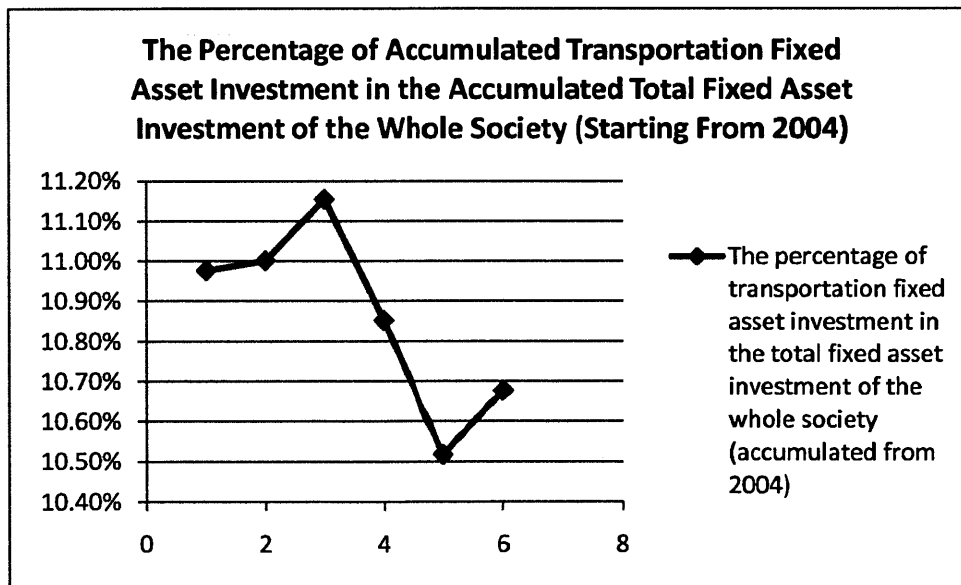
Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

Figure 2-9 Accumulated Fixed Asset Investment of the Transportation Industry and the Whole Society



Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

Figure 2-10 The Percentage of Accumulated Transportation Fixed Asset Investment in the Accumulated Total Fixed Asset Investment of the Whole Society (Starting From 2004)



Source: National Bureau of Statistics of China, 2010, Retrieved Dec 2nd, 2010 from <http://www.stats.gov.cn/tjsj/>

From Table 2-7, Table 2-8, Figure 2-7, Figure 2-8, Figure 2-9, and Figure 2-10, we can see from 2004 to 2009, the percentage of the annual transportation fixed asset investment in the annual total fixed asset investment fluctuated in narrow range from 9.5% to 11.5%. From Table 1-8 and Figure 1-10, we can see from 2004 to 2009, the percentage of accumulated transportation fixed asset investment in the accumulated total fixed asset investment starting from 2004 fluctuated in narrower range from 10.5% to 11.2%. All these indicate that the transportation fixed asset investment is pretty stable in the percentage of the total fixed asset investment, even after the start of massive HSR building in 2008.

2.2.3. Crowding Out Effect of HSR Investments in China

Figure 2-2 shows the change of fixed asset investments of different transportation modes from 2005 to 2009. From this figure, we can conclude that if we define crowding out effect as the effect that investments in other transportation modes decrease when HSR is being built, no crowding out effect exists here since investments in all transportation modes increase.

Figure 2-4 shows the change of the ratios of fixed asset investment of different transportation modes divided by the total fixed asset investment of the society from 2005 to 2009. From this figure we can conclude that if we define crowding out effect as the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment of the society when HSR is being built, crowding out effect exists here: building of HSR crowds out investments in roads and aviation, but not crowds out investments urban transportation and waterway.

In addition, according to Table 2-3, railway investments increase from 1.4% of the total fixed asset investment of the society in 2004 to 3.5% in 2009; road investments drop from 7.5% of the total fixed asset investment of the society in 2004 to 5.3% in 2009; aviation investments drop from 0.5% of the total fixed asset investment in 2004 to 0.3% in 2009: the scale of railway investments is large, the scale changes of railway and road investments are significant in both absolute value and relative value compared to their original ones, the scale change of aviation industry is not significant in absolute value but significant in relative value. Therefore, we can further conclude that the crowding out effect is significant on both road and aviation projects in the sub-definition 2.

Figure 2-6 shows the change of the ratios of fixed asset investment of different transportation modes divided by the total fixed asset investment of the transportation industry from 2005 to 2009. From this figure, we can conclude that if we define crowding out effect as the effect that investments in other

transportation modes decrease as a percentage of the total fixed asset investment in transportation when HSR is being built, crowding out effect exists here: building of HSR crowds out investments in roads, waterway, and aviation, but does not crowd out investments urban transportation.

In addition, according to Table 2-5, railway investments increase from 12.8% of total fixed asset investment of the transportation industry in 2004 to 31.8% in 2009; road investments drop from 68.6% of total fixed asset investment of the transportation industry in 2004 to 48.3% in 2009; waterway investments drop from 8.2% of the transportation industry in 2004 to 7.7% in 2009; aviation investments drop from 4.2% of the transportation industry in 2004 to 2.8% in 2009: the scale of railway investments is large, the scale changes of railway and road are also significant in both the absolute and relative value, the scale change of aviation industry is not significant in absolute value but significant in relative value, and the scale change of waterway is neither significant in absolute nor relative value. Therefore, we can further conclude that the crowding out effect is significant on both road and aviation projects, but not significant on waterway projects.

Therefore, as illustrated in Table 2-9, we will reach different conclusions for crowding out effect depending on how we define crowding out effect.

Table 2-9 Crowding Out Effect---China

	Road	Urban transport	Waterway	Aviation
Sub-definition 1: the effect that investments in other transportation modes decrease when HSR is being built	No	No	No	No
Sub-definition 2: the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment of the society when HSR is being built	Yes, significant	No	No	Yes, significant
Sub-definition 3: the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment in transportation when HSR is being built	Yes, significant	No	Yes, not significant	Yes, significant

Source: summarized by the author

2.3. Germany

2.3.1. Overview of Germany's Transportation Investment

Germany is a federally organized nation and it has a cooperative federal system, which consists of the federal government (Bund), the federal states (Bundesländer), and communities (Gemeinden). In this cooperative system, most of the infrastructure investment decisions are made by the federal government, while the states are only responsible for implementation. In the case of transportation, the federal government shoulders the responsibility for planning, financing, constructing, maintaining and operating federal roads and trunk roads, federal railways (including HSR), and inland waterways, while the states are responsible for the building of airports and sea ports. The general public budget is the main source for funds for transportation infrastructure investments in Germany, which means that on one hand most infrastructure investments are funded through the general public budget; on the other hand user charges such as vehicle taxes and mineral oil taxes are not dedicated funding sources for the transportation sector. (Astrid Güneman, 2005)

2.3.2. The Federal Transport Infrastructure Plan 2003

One of the most important transportation infrastructure investment planning tools is *The Federal Transport Infrastructure Plan (2003)*, which provides a view for the transportation infrastructure investments towards 2015. This FTIP 2003 considers all types of transportation projects together, e.g. truck roads, railways, and etc. and set priorities based on certain criteria, such as benefit-cost ratios, network design considerations, the status of planning and the level of investments that is likely to be available over the lifetime of the plan, environmental and nature conservation influences, and ecological risks they pose (BMVBS, 2010a).

The total investment budget for projects in the FTIP 2003 is 149 billion Euros from 2001 to 2015 in total: 83 billion Euros are for maintenance, and 66 billion Euros are for building new projects (BMVBS, 2010a). Two kinds of projects, the first and second priority projects are listed in FTIP 2003. The investment budget is just used to build the first priority projects. The government may not be able to build the second priority projects although these projects have been proven to be able to bring social benefits. (BMVBS, 2010b)

2.3.3. Planning of HSR Investment in Germany

In the end of 2003, the total length of the HSR network in Germany was close to 1900km. HSR projects are treated the same as other projects and are prioritized using the same criteria in FTIP 2003. HSR projects in the FTIP 2003 are listed below (BMVBS, 2010b):

In the category of “ongoing and definitely planned first priority rail projects” (first priority category), 1.8298 billion Euros out of 17.9324 billion Euros are invested in HSR projects till 2015, including:

- Upgrade the Hamburg-Buchen-Berlin lines ($V_{max}=230$ km/h, 563.8 million Euros)
- Construct new line between Stuttgart and Ulm for 250 km/h, incl. integration in Stuttgart hub; upgrade between Ulm and Augsburg for speeds up to 200 km/h (1266.0 million Euros)

In the category of “new first priority rail projects” (first priority category), less than 9.694 billion Euros out of 15.9933 billion Euros are invested in HSR projects:

- Construct new double-track lines from Lauenbrück to Isernhagen ($V_{max}=300$ km/h, part of 1.2839 billion Euros)
- Upgrade the Seelze-Wunstorf-Minden lines/construct new lines ($V_{max}=230$ km/h, 901.3 million Euros)
- Upgrade the Hanau-Wurzburg/Fulda—Erfurt lines/construct new lines (construct new double-track lines between Gelnhausen and Mottgers with grade-separated connecting curves towards Fulda and Burgsinn linking the new line to the existing Fulda-Wurzburg High-Speed Rail line, $V_{max}=300$ km/h, part of 2.250 billion Euros)
- Construct new Rhine/Main—Rhine/Neckar lines ($V_{max}=300$ km/h, 1.7714 billion Euros)
- Upgrade the Augsburg-Munich lines ($V_{max}=230$ km/h, 328.4 million Euros)
- Upgrade the Karlsruhe-Offenburg-Freiburg-Basle lines/construct new lines ($V_{max}=250$ km/h, part of 2.8231 billion Euros)
- Upgrade the Munster-Lunen line ($V_{max}=200$ km/h, 177.0 million Euros)
- Upgrade the Neu-Ulm-Augsburg lines ($V_{max}=200$ km/h, 158.9 million Euros)

2.3.4. Crowding Out Effect of HSR Investments in Germany

In Germany, *The Federal Transport Infrastructure Plan (2003)* is the most important planning tool for all types of transportation projects together, e.g. HSR, truck roads, conventional railways, and etc. In the FTIP 2003, the HSR investments are only about 7.7% of the total transportation infrastructure investments from 2001 to 2015. If these potential HSR projects didn't exist, the federal government may use this extra money to move on the second priority transportation projects. Therefore, if we consider the third sub-definition of crowding out effect, the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment in transportation when HSR is being built, the crowding out effect of HSR does exist in Germany. But since the HSR only account for a small portion, the crowding out effect may not be significant.

Noticing that all transportation infrastructure projects, including HSR projects are prioritized based on certain scientific criteria, such as benefit-cost ratios, network design considerations, and so on, we can also see the building of HSR are very well justified in the FTIP 2003 even though the crowding out effect exists. The crowding out effect of HSR investments on other transportation projects in Germany is illustrated in Table 2-10.

Table 2-10 Crowding Out Effect--Germany

Germany	Road	Urban transport	Waterway	Aviation
Sub-definition 1: the effect that investments in other transportation modes decrease when HSR is being built	NA	NA	NA	NA
Sub-definition 2: the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment of the society when HSR is being built	NA	NA	NA	NA
Sub-definition 3: the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment in transportation when HSR is being built	Probably yes, and not significant	Probably yes, and not significant	Probably yes, and not significant	Probably yes, and not significant

Source: summarized by the author

2.4. Taiwan

2.4.1. HSR Investment in Taiwan

Taiwan High-Speed Rail (THSR) is a High-Speed Rail network that runs along the west coast of Taiwan. It is approximately 345 km long and it runs from Taipei to Kaohsiung. The THSR plan began in 1997. The infrastructure construction began in 2000. The service starting date was estimated to be in Oct.2005, but was delayed to January 5, 2007. The construction phrase lasted for 10 years, from 1997 to 2006. The project had a total cost of 18 billion USD. (Taiwan High-Speed Rail, 2011) This HSR project is one of the largest privately managed and funded transportation projects up to 2007. (Shima, 2007)

In November 1994, Taiwan passed a law about the involvement of private capital in infrastructure projects, which also applied to the THSR project. Consequently, in 1995, the Provisional Engineering Office of High Speed Rail (POHSR) was transformed into the Bureau of High-Speed Rail (BOHSR), which started to tender THSR as a build-operate-transfer (BOT) scheme in October 1996 (Taiwan High-Speed Rail, 2011).

In a prolonged bidding process, the Taiwan High-Speed Rail Consortium (THSRC) ran against the Chungwa High-Speed Rail Consortium (CHSRC). THSRC, founded by five domestic companies, submitted the cheaper bid by promising to pay 3.1 billion USD and to build the line with zero net cost for the government, was chosen as the preferred bidder in September 1997 (I-Tsung Tsai, 2007). The group was renamed and formally established as the Taiwan High-Speed Rail Corporation (THSRC) in May 1998. THSRC and the government finally signed the BOT agreement on July 23, 1998 (Taiwan High-Speed Rail, 2011). More details of financing will be illustrated in Chapter 3, *Difference between Financing HSR and Other Transportation Projects*.

2.4.2. The New Ten Major Construction Projects

When THSR was still in its construction phrase, or in November 2003, the premier Yu Shyi-kun introduced The New Ten Major Construction Projects, a construction plan in Taiwan. The total investment for this plan within five years was estimated to be NT\$500 billion, or 16.5 billion USD. Within these ten projects, four were transportation projects: TRA MRTization, The Third Wave of Freeway Construction, Kaohsiung Harbor Intercontinental Container Port Center, and northern, central, and southern metro system (Council for Economic Planning and Development (Taiwan), 2011).

TRA MRTization was a plan of improving short-distance and middle-distance transportation quality of railway lines in the west part of Taiwan (Council for Economic Planning and Development (Taiwan), 2011). The total estimated costs for these 12 TRA MRTization projects were more than NT\$130 billion, or 4.3 billion USD (Council for Economic Planning and Development (Taiwan), 2011). The Third Wave of Freeway Construction was a plan of building 8 road projects in Taiwan, for example, Zhitou Freeway (Council for Economic Planning and Development (Taiwan), 2011). Kaohsiung Harbor Intercontinental Container Port Center was built to enhance the competitiveness of Kaohsiung. The first phase of this project was built using BOT and the total costs of the first phase were estimated to be NT\$ 15 billion, or about 500 million USD (Council for Economic Planning and Development (Taiwan), 2011).

2.4.3. Crowding Out Effect of HSR Investments in Taiwan

In November 2003, when Taiwan HSR project was still in its construction and financing process, Taiwan government established The New Ten Major Construction Projects and started the building of other transportation projects, such as local railways, roads, sea ports and so on.

It is hard to find direct evidence to prove whether HSR in Taiwan crowds out the investments in other transportation modes. If we consider the first sub-definition the effect that investments in other transportation modes decrease when HSR is being built, the THSR building in Taiwan may not crowd out the building of other transportation infrastructures because the Taiwan government planned to invest significantly in other transportation modes when HSR was still in its financing and construction phase. The crowding out effect of HSR investments on other transportation projects is illustrated in Table 2-11.

Table 2-11 Crowding Out Effect---Taiwan

Taiwan	Road	Urban transport	Waterway	Aviation
Sub-definition 1: the effect that investments in other transportation modes decrease when HSR is being built	Probably no	Probably no	Probably no	Probably no
Sub-definition 2: the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment of the society when HSR is being built	NA	NA	NA	NA
Sub-definition 3: the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment in transportation when HSR is being built	NA	NA	NA	NA

Source: summarized by the author

2.5. Japan

2.5.1. Overview of Japan's Transportation Investment

Japan has a very modern transportation system, including all road, railway, airport and urban transportation projects. Japan has an approximately 1.2 million kilometer road network. Major cities are typically connected by high-speed toll roads operated by toll-collecting enterprises. Japan has a 23,670.7 km length railway network including 2,893.1 km of the entirely electrified standard gauge one and 89.8 km of narrow gauge. There are a lot of Japanese railway companies competing in both regional and local passenger transportation markets, such as the six JR companies (JR East, JR Central, JR West, JR Hokkaidō, JR Shikoku and JR Kyūshū), Kintetsu Corporation, etc. These companies often build real estate or department stores next to stations to get a significant amount of non-transportation revenues. Shinkansen are the High-Speed Trains in Japan operating in a frequency of about 250 Shinkansen trains daily. The fastest shinkansen trains are the N700 series Nozomi, which operate at a maximum speed of 300 km/h. There are 173 airports in Japan. The largest international gateways are Narita International

Airport (Tokyo area), Kansai International Airport (Osaka/Kobe/Kyoto area), and Chūbu Centrair International Airport (Nagoya area). (Wikipedia, 2011f)

The fixed asset investment of different transportation modes is illustrated in Table 2-12:

Table 2-12 Fixed Asset Investment in Different Transportation Modes (Japan), Billion USD

	2008	2009
Road investment	14.573	12.22
Seaport	2.279	2.195
Airport	1.536	1.429
Urban railway	0.39	0.36
HSR	0.706	0.706
Aid to navigation for Airplane and Ships	0.052	0.052
Total	19.536	16.962

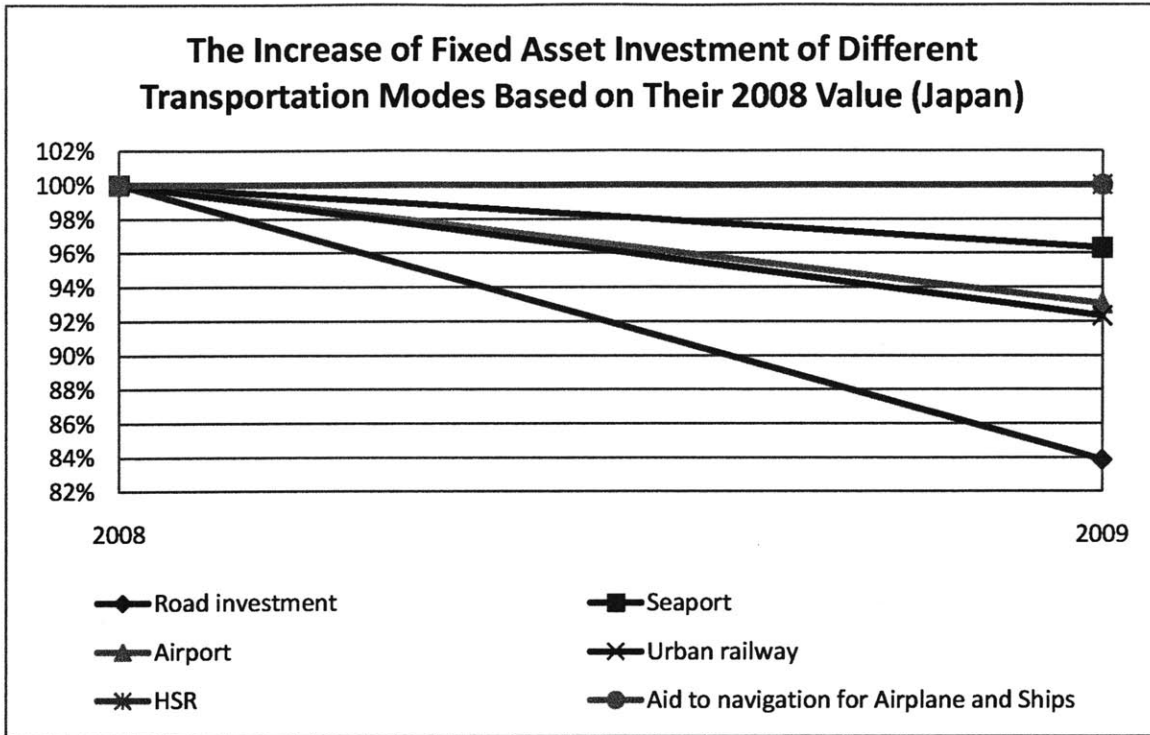
Source: Sakamoto, Personal communication, Jan 17, 2011

Table 2-13 The Increase of Fixed Asset Investment of Different Transportation Modes Based on Their 2008 Value (Japan)

	2008	2009
Road investment	100%	83.85%
Seaport	100%	96.31%
Airport	100%	93.03%
Urban railway	100%	92.31%
HSR	100%	100.00%
Aid to navigation for Airplane and Ships	100%	100.00%

Source: Sakamoto, Personal communication, Jan 17, 2011

Figure 2-11 The Increase of Fixed Asset Investment of Different Transportation Modes Based on Their 2008 Value (Japan)



Source: Sakamoto, Personal communication, Jan 17, 2011

From Table 2-12, Table 2-13, and Figure 2-11 above, we can see in Japan, the investments in roads, seaports, airports and urban railways decreased from 2008 to 2009, and only the investments in HSR maintained the same level.

Table 2-14 Fixed Asset Investment of Different Transportation Mode / Total Fixed Asset Investment in Transportation (Japan)

	2008	2009
Road investment	74.60%	72.04%
Seaport	11.67%	12.94%
Airport	7.86%	8.42%
Urban railway	2.00%	2.12%
HSR	3.61%	4.16%
Aid to navigation for Airplane and Ships	0.27%	0.31%
Total	100%	100%

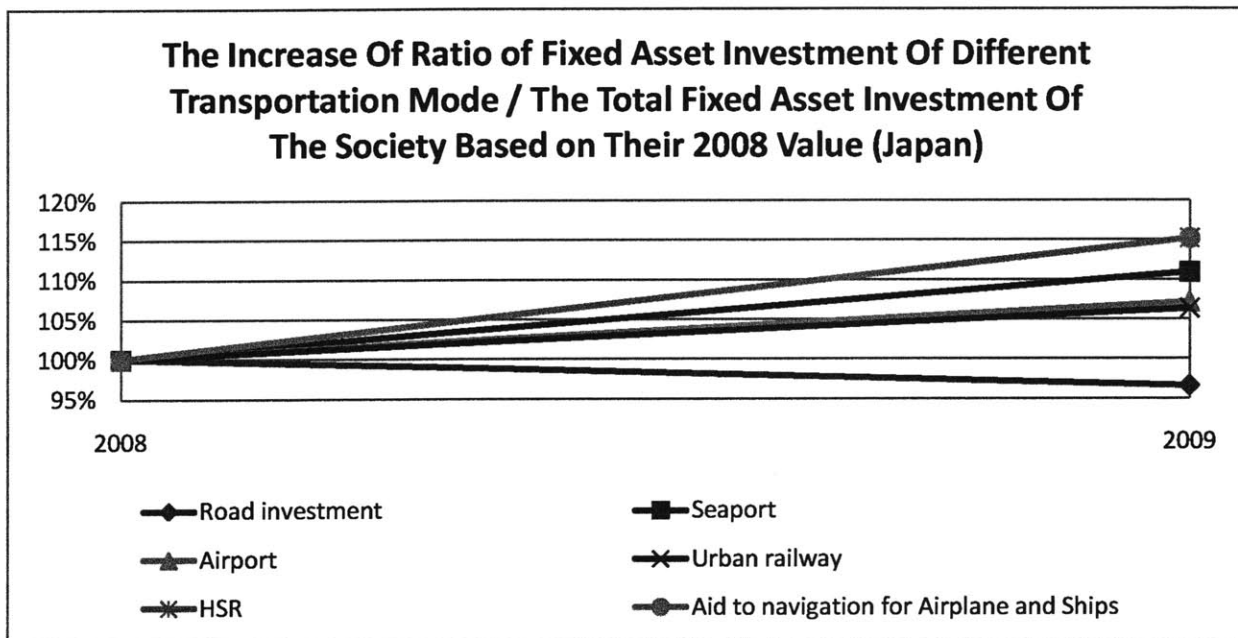
Source: Sakamoto, Personal communication, Jan 17, 2011

Table 2-15 The Increase of Ratio of Fixed Asset Investment of Different Transportation Modes / The Total Fixed Asset Investment of the Society Based on Their 2008 Value (Japan)

	2008	2009
Road investment	100%	96.58%
Seaport	100%	110.93%
Airport	100%	107.15%
Urban railway	100%	106.32%
HSR	100%	115.18%
Aid to navigation for Airplane and Ships	100%	115.18%

Source: Sakamoto, Personal communication, Jan 17, 2011

Figure 2-12 The Increase of Ratio of Fixed Asset Investment of Different Transportation Mode / The Total Fixed Asset Investment of The Society Based on Their 2008 Value (Japan)



Source: Sakamoto, Personal communication, Jan 17, 2011

From Table 2-14, Table 2-15, Figure 2-12 above, we can conclude the fixed asset investments in HSR and urban railways, seaports and airports increased as a percentage of the total fixed asset investments in transportation from 2008 to 2009, with the investments in HSR increasing by the largest percentage. At the same time the fixed asset investments in roads decreased as a percentage of the total fixed asset investments in transportation increased from 2008 to 2009.

2.5.2. Crowding Out Effect of HSR Investments in Japan

We can see the crowding out effect of HSR investments by analyzing Figure 2-11 and Figure 2-12. We will reach different conclusions for the crowding out effect if we define crowding out effect differently.

Figure 2-11 shows the change of fixed asset investments of different transportation modes from 2008 to 2009. From this figure, we can conclude if we define crowding out effect as the effect that investments in other transportation modes decrease when HSR is being built, the crowding out effect exists here since investments in all other transportation modes decreased. However, according to Table 2-12, since the scale of HSR investments is very small compared to the investments of roads, the crowding out effect on roads cannot be significant. On the other hand, the scale change of seaports, urban rails and airport investments is small in both absolute and relative value, so the crowding out effect on these projects are also limited.

Figure 2-12 shows the change of the ratio of fixed asset investments divided by the total fixed asset investments of the society from 2008 to 2009. From this figure, we can conclude that if we define crowding out effect as the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investments of the society when HSR is being built, the crowding out effect only exists on road projects. According to Table 2-14, since the scale of HSR investments is very small compared to the investments of roads, the crowding out effect on roads cannot be significant.

The crowding out effect of HSR investments on other transportation projects is illustrated in Table 2-16.

Table 2-16 Crowding Out Effect---Japan

	Road	Urban Rail	Seaport	Aviation
Sub-definition 1: the effect that investments in other transportation modes decrease when HSR is being built	Yes, not significant	Yes, not significant	Yes, not significant	Yes, not significant
Sub-definition 2: the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment of the society when HSR is being built	NA	NA	NA	NA
Sub-definition 3: the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment in transportation when HSR is being built	Yes, not significant	No	No	No

Source: summarized by the author

2.6. Conclusion

The crowding out effect of China, Germany, Taiwan and Japan can be summarized in Table 2-17:

Table 2-17 Crowding Out Effect Summary

	China	Germany	Taiwan	Japan
Sub-definition 1: the effect that investments in other transportation modes decrease when HSR is being built	No	NA	Probably no	Yes, not significant
Sub-definition 2: the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment of the society when HSR is being built	Yes, significant	NA	NA	NA
Sub-definition 3: the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investment in transportation when HSR is being built	Yes, significant	Yes, not significant	NA	Yes, not significant

Source: summarized by the author

After analyzing Table 2-9, Table 2-10, Table 2-11, Table 2-16, and Table 2-17, we can draw the following conclusions:

- If we define the crowding out effect as the effect that investments in other transportation modes decrease when HSR is being built, crowding out effect of HSR projects generally not exists. The only exception is Japan, although the crowding out effect is also not significant.
- If we define the crowding out effect as the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investments of the society when HSR is being built or the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investments in transportation when HSR is being built, crowding out effect of HSR projects generally exists. This crowding out effect is significant in China, but not significant in Germany and Japan.
- In China, if we consider the second and third sub-definitions of the crowding out effect, we can see HSR investments significantly crowd out road and aviation investments, but don't crowd out urban transport and waterway investments. In Japan, if we consider the third sub-definition of the crowding out effect, we can see HSR investments crowd out road investments, but don't crowd out investments of other transportation modes; and this crowding out effect in Japan is also insignificant.
- Although crowding out effect exists in the world, we cannot find evidences of the crowding out effect of HSR investments on urban transportation investments. This may mean that governments around the world have all realized that HSR cannot bring real time saving benefits without the corresponding support from urban transportation.
- Crowding out effect exists in the world: this effect is generally significant in the countries in the initial stage of the formation of their HSR system, e.g. China; this effect is generally insignificant in the countries with mature HSR system, e.g. Germany and Japan. We believe Portugal is also in the initial stage of the HSR system formation just as China does, and Portugal needs to pay attention to this crowding out effect when building new HSR projects in the future. In the following chapters, we will use innovative financing methods and identify megaregion revenues to make HSR investments more financially viable. And this will also help counter the negative crowding out effect of HSR investments.

3. Difference between Financing HSR and Other Transportation Projects

3.1 Overview

In this chapter, we compare HSR financing with the financing of other transportation projects in five different countries: China, Germany, Taiwan, Portugal and Japan. We try to identify the characteristics of HSR financing in general, identify potential problems of the current HSR financing mechanism in Portugal, and figure out potential ways to improve the HSR financing mechanism in Portugal.

3.2 China

3.2.1. Overview of China's Funding Sources for Transportation Projects

In China, the central government is responsible for building most of the infrastructure across the country. In the case of transportation infrastructure, most of the funds for building national railway (including HSR), national road system, and national inland waterway system come from the central government. Airports construction seems to be the only exception with only about one quarter of the funds coming from the central government.

3.2.2. Railway System of China

Railways are the most commonly used mode of long-distance transportation in the People's Republic of China. Almost all railways are operated by the Ministry of Railway (MOR), which is a part of the State Council of the People's Republic of China. In October 2008, the Chinese State Council approved a new 2 trillion RMB (292 billion USD) railway investment plan to take it up to 2020. The scheme extended China's previously announced railway building program, which was allocated 1.25 trillion RMB (182 billion USD) in the 11th five-year plan from 2006 to 2010. (The Economic Observer Online, 2008) As a result of the increased investments, the country's railway network grew to 91,000km by the end of 2010. Growth in freight transportation is thought to be one of the drivers behind the increased focus on rail, and the need to increase railway capacity to meet rising demand (Liang, 2011).

Total investments in new rail lines grew from 14 billion USD in 2004 to 22.7 billion USD in 2006 and to 25.6 billion USD in 2007. In response to the 2008 global economic recession, the government accelerated

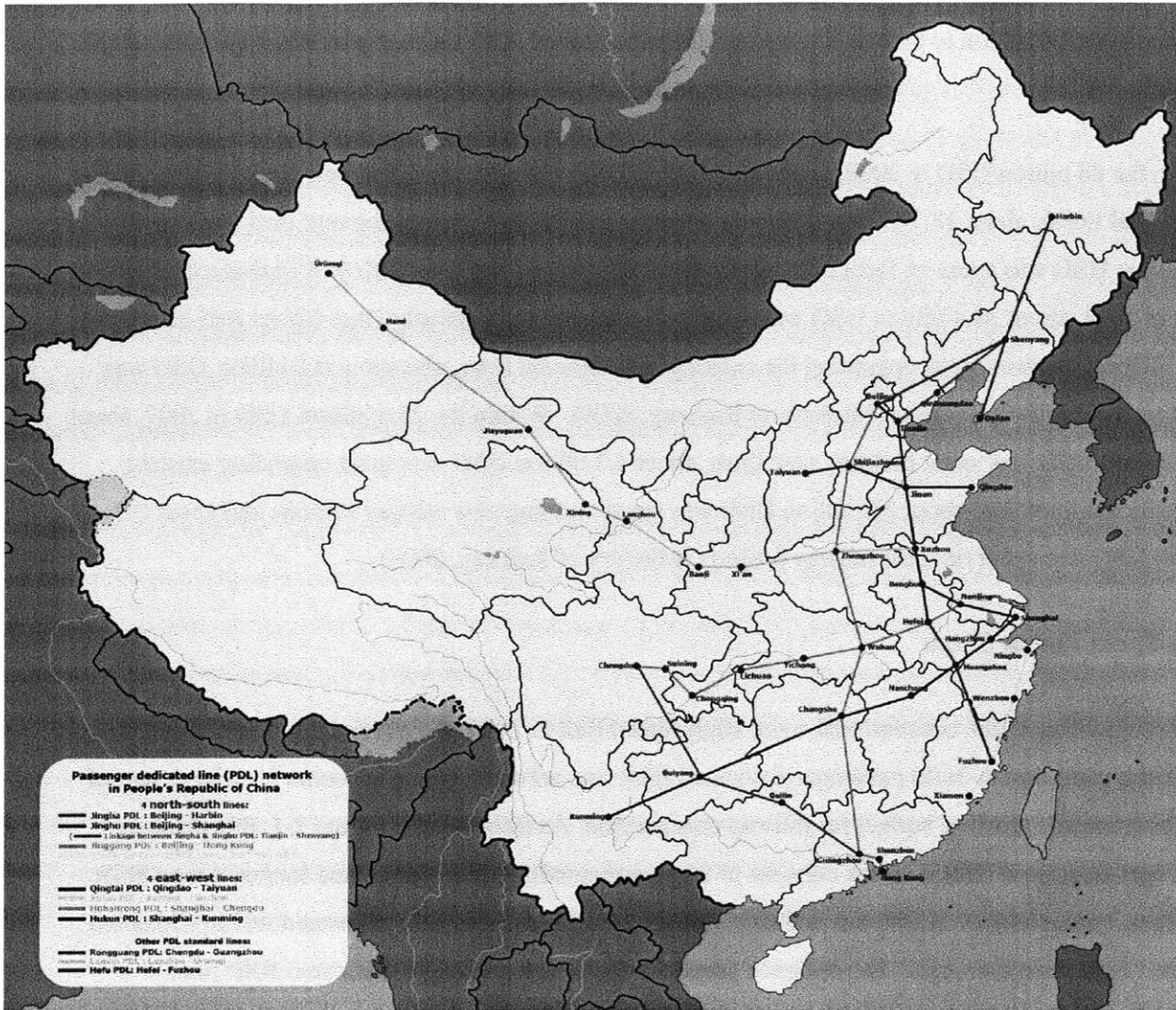
the pace of HSR expansion to stimulate domestic economic growth. Total investments in new rail lines including HSR lines reached 49.4 billion USD in 2008 and 88 billion USD in 2009. In all, the state plans to spend US\$300 billion to build a 25,000 km HSR network by 2020 (Ministry of Railway, 2008, 2009, 2010).

Within the 88 billion USD in 2009, about 68.8 billion USD was spent building new lines (mostly High-Speed Rail lines), about 18.7 billion USD was spent upgrading the existing conventional lines, and about 0.5 billion USD was spent on local railway projects (Ministry of Railway, 2010). Within the 49.4 billion USD in 2008, about 38.4 billion USD was spent building new lines (mostly High-Speed Rail lines), about 10.6 billion USD was spent upgrading the existing conventional lines, and about 0.4 billion USD was spent on local railway projects (Ministry of Railway, 2009). Within the 25.6 billion USD in 2007, about 18.9 billion USD was spent building new lines, about 4.3 billion USD was spent upgrading existing conventional lines, and about 2.2 billion USD was spent building new railway stations and about 0.2 billion USD was spent on local railway projects (Ministry of Railway, 2008).

High-Speed Rail in China

After committing to the conventional-track High-Speed Rail in 2006, the government has embarked on an ambitious campaign to build passenger-dedicated HSR line network, which accounts for a large part of the government's growing budget for railway construction. As illustrated in Figure 3-1, this planned passenger-dedicated HSR network consists of four north-south HSR corridors and four east-west HSR corridors, with a total of 16,000 km in 2020. This planned HSR network is connected within China but isolated from other countries. The designed speed for these new passenger-dedicated HSR lines is 350km/h, but China planned to decrease this speed due to safety concern and energy consideration. More details of this are illustrated in Appendix A. And the designed speed for other mixed used HSR lines is 250km/h. (Ministry of Railway (China), 2008)

Figure 3-1 The Planned Passenger-Dedicated HSR Line Network in China



Source: Wikipedia. 2011i.

The length of the Chinese HSR network was close to 8385 km in the end of 2010. (Liang, 2011) 12 HSR lines with the designed speed of 250km/h, and 5 HSR lines with the designed speed of 350km/h have opened to service. These HSR lines are illustrated in Table 3-1 and Table 3-2:

Table 3-1 Chinese Open-Service HSR Lines with the Designed Speed of 250km/h

Line	Length	Construction cost (Total)	Construction cost (per km)
Qinshen PDL	404 km	15.7 billion RMB (2.4 billion USD)	38.9 million RMB (5.9 million USD)
Hening PDL	166 km	25 billion RMB (3.8 billion USD)	150.6 million RMB (22.7 million USD)
Jiaoji PDL	364 km	11 billion RMB (1.7 billion USD)	30.21 million RMB (4.6 million USD)
Shitai PDL	190 km	17.075 billion RMB (2.57 billion USD)	89.87 million RMB (13.5 million USD)
Hewu PDL	351 km	16.8 billion RMB (2.53 billion USD)	47.86 million RMB (7.21 million USD)
Yongtaiwen PFL	268 km	16.28 billion RMB (2.45 billion USD)	60.75 million RMB (9.16 million USD)
Wenfu PFL	298 km	18 billion RMB (2.71 billion USD)	60.4 million RMB (9.1 million USD)
Fuxia PFL	275 km	15.259 billion RMB (2.3 billion USD)	55.49 million RMB (8.36 million USD)
Chengguan PDL	65 km	13.3 billion RMB (2 billion USD)	204.62 million RMB (30.8 million USD)
Changjiu ICL	131 km	5.832 billion RMB (0.88 billion USD)	44.52 million RMB (6.7 million USD)
Changji ICL	111 km	9.6 billion RMB (1.5 billion USD)	86.49 million RMB (13.15 million USD)
Hainan ER ICL	308 km	20.2 billion RMB (3.1 billion USD)	65.58 million RMB (9.97 million USD)

Source: Wikipedia. 2011i.

Table 3-2 Chinese Open-Service HSR Lines with the Designed Speed of 350km/h

Line	Length	Construction cost (Total)	Construction cost (per km)
Jingjin ICL	115 km	21.5 billion RMB (3.24 billion USD)	186.96 million RMB (28.17 million USD)
Wuguang PDL	968 km	116.6 billion RMB (17.57 billion USD)	120 million RMB (18.08 million USD)
Zhengxi PDL	455 km	35.31 billion RMB (5.32 billion USD)	77.6 million RMB (11.7 million USD)
Huning HSR	301 km	50 billion RMB (7.5 billion USD)	166.11 million RMB (25 million USD)
Huhang PDL	150 km	29.29 billion RMB (4.4 billion USD)	195.27 million RMB (29.4 million USD)

Source: Wikipedia. 2011i.

The Construction of Chinese High-Speed Rail projects are primarily funded by state owned banks and financial institutions, which lend money to the MOR and local governments. The MOR, through its financing arm, the China Rail Investment Corp (CRIC), issued an estimated ¥1 trillion (150 billion USD in 2010 dollars) in debt to finance the HSR construction from 2006 to 2010, including ¥310 billion in the first 10 months of 2010. The CRIC also raised some capital through equity offerings; in the spring of 2010, the CRIC sold a 4.5 percent stake of the Beijing-Shanghai High-Speed Rail to the Bank of China for ¥6.6 billion and a 4.537 percent stake to the public for ¥6 billion. The CRIC retained 56.2 percent equity on the Beijing-Shanghai HSR project. The CRIC bonds are considered to be relatively safe investments because they are backed by assets (the railways) and implicitly by the central government of China (Niu, 2010).

Up to now, only two public railway companies, the Guangzhou-Shenzhen Railway Company and the Daqing Railway Company, are listed in the Stock Exchanges in China. They are both profitable companies: the Guangzhou-Shenzhen Railway Company has strong passenger transport demand with very high load factor, and the Daqing Railway has strong coal freight transport demand. Up to now, no pure High-Speed Rail company has gone public in China.

From the analysis above, we can conclude that HSR and other national railway projects are both primarily financed by the MOR, and local and provincial governments. No obvious distinction exists between HSR financing and other railway project financing. Connecting the two biggest cities Beijing and Shanghai, the Beijing-Shanghai HSR project is one of the most important HSR projects in China. We will discuss the financing of this Beijing-Shanghai HSR in more detail below.

The Beijing-Shanghai HSR project

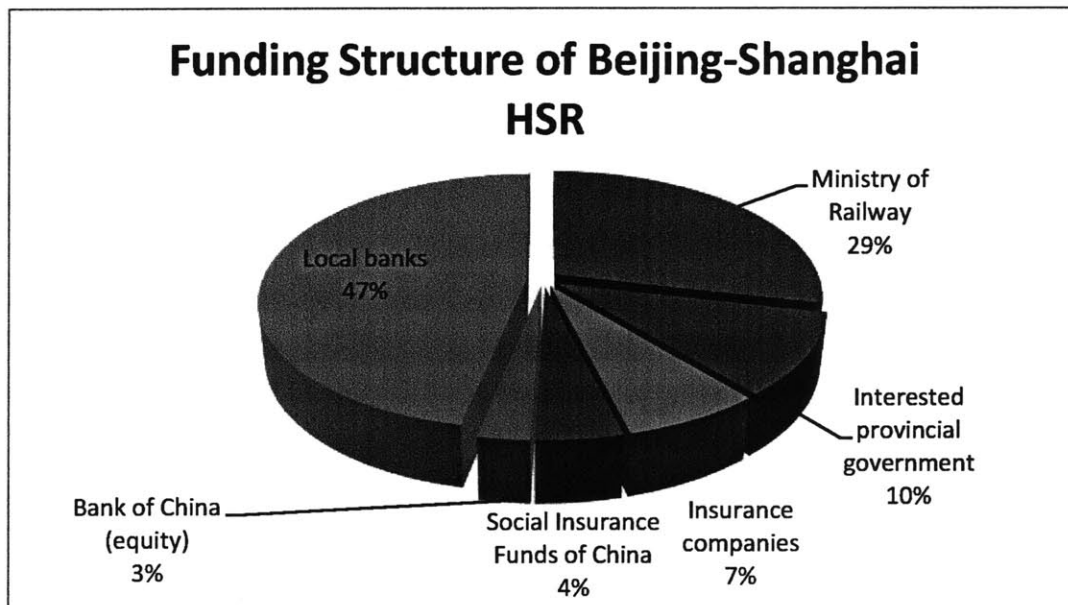
The Beijing-Shanghai High-Speed Rail is a 1318 kilometers (819 miles) long HSR line that connects two major economic zones in the People's Republic of China: the Bohai Sea Rim and the Yangtze River Delta. Construction of this HSR line began on April 18, 2008; it is expected to be put into commercial service in June, 2011. (NetEase Website, 2011)

On Dec. 27th, 2007, the Beijing-Shanghai HSR Company was established to be formally in charge of this HSR project. It has been fully responsible for raising funds for the construction, managing construction and operation process, paying back debt and interest, and managing the HSR asset. The eleven sponsors of this Beijing-Shanghai HSR Company include the Chinese Railway Investment Company, Ping An

Insurance (Group) Company, the Social Insurance Funds of China, Shanghai Shentie Investment Limit, Jiangsu Transportation Company, Beijing Infrastructure Investment Company, Tianjin Infrastructure Investment Company, Nanjing Railway Investment Company, Shangdong Road Group, Hebei Transportation Investment, and Anhui Investment Group. All these eleven sponsors are the equity owners of the Beijing-Shanghai HSR Company (Gao, 2008).

The total construction costs of the Beijing-Shanghai HSR are about 32.48 billion USD. Within all these 32.48 billion USD, about 16.91 billion USD, or 52 % are financed in the form of equity. The MOR provides 9.51 billion USD equity, or 51.7% of the total equity. Related provincial government provides 3.44 billion USD, or 20.3% of the total equity. Seven state owned companies, such as Ping An Insurance (Group) Company, provides 2.35 billion USD in total, or 13.9% of the total equity. The Social Insurance Funds of China provides 1.47 billion USD, or 8.7% of the total equity (Gao, 2008). Bank of China, provides 0.88 billion, or 4.5% of the total equity (Zhang, 2010). And the left 15.57 billion USD, or 48% of the total construction costs, is borrowed from several local banks (Gao, 2008). The funding structure of the Beijing-Shanghai HSR is illustrated in Figure 3-2.

Figure 3-2 Funding Structure of Beijing-Shanghai HSR



Source: Gao, 2008; Zhang, 2010

3.2.3. Road and Inland Waterway System in China

The Ministry of Transport of the People's Republic is the executing agency in charge of building the national road system, national inland waterway system and national sea ports. According to its annual statistic report in Table 3-3, we have:

Table 3-3 Investment in Roads, Waterways and Sea Ports (China)

	Total (US\$ billi)	National Roads (US\$ billions)	Inland Waterway	Sea Ports and Other Related Facilities (US\$ billions)	Others (US\$ billio)
2007	100.29	85.64	2.16	8.74	3.76
2008	104.80	88.17	2.41	9.66	4.57
2009	144.33	127.32	3.59	9.70	3.73
Jan.2010 to Sep.2010	128.09	114.95	2.92	7.49	2.72

Source: Ministry of Transport (2010). Annual statistical Report of Roads, Waterways, Seaports Development in 2009 (2009年公路水路交通运输行业发展统计公报). Retrieved Nov. 2010 from

http://www.moc.gov.cn/zhuzhan/tongjigongbao/fenxigongbao/hangyegongbao/201009/t20100916_811433.html

In the end of 2009, the total length of the national road system was 3.86 million km, increased by 0.13 million km compared to 2008. In more detail, the length of the Chinese national roads, provincial roads, country-level roads and township-level roads was 158.5 thousand km, 266.0 thousand km, 519.5 thousand km, and 1.0196 million km respectively, increased by 3.2 thousand km, 2.8 thousand km, 7.2 thousand km, and 8.4 thousand km respectively. We can also classify the Chinese road system into expressways, first-class roads, second-class roads, third-class roads, fourth-class roads, and substandard roads. In the end of 2009, the total length of expressways, first-class roads, second-class roads, third-class roads, fourth-class roads, and substandard roads was 65.1 thousand km, 59.5 thousand km, 300.7 thousand km, 379.0 thousand km, 2.252 million km, and 804.6 thousand km respectively, increased by 4.8 thousand km, 5.2 thousand km, 15.5 thousand km, 4.8 thousand km, 247.5 thousand km, and 147.1 thousand km respectively (Ministry of Transport, 2010).

Road

The total costs of the Chinese road network are estimated to be 2 trillion RMB (240 billion USD). The annual investment was estimated to run from 140 billion RMB (17 billion USD) to 150 billion RMB (18

billion USD) from 2005 to 2010, and the annual investment will be around 100 billion RMB from 2010 to 2020 (12 billion USD). The construction fund will come from vehicle purchase tax, fees and taxes collected by local governments, state bonds, domestic investment and foreign investment (Wikipedia, 2010a).

Unlike other road projects, almost all of roads on the NTHS/"7918 Network" are toll roads largely financed using PPP, by which we mean they are financed by private companies under contract with provincial governments. The private companies raise money through bank loans, or bond and stock offerings and recover money through tolls. The new 7918 Network is composed of:

- 7 radial expressways leaving Beijing (G1-G7)
- 9 north-south expressways(double digit G roads with numbers ending in an odd numeral)
- 18 west-east expressways(double digit G roads with numbers ending in an even numeral)

In addition, asset based securities⁸ are also used to finance the road construction in China. One example is Guangzhou-Shenzhen-Zhuhai expressway, which will be discussed in more detail below.

The Guangzhou-Shenzhen-Zhuhai Expressway

In China, the Guangzhou-Shenzhen-Zhuhai expressway is the pioneer in using asset based securities (ABS)⁹ to gather money for its construction.

The Guangzhou-Shenzhen-Zhuhai expressway runs across Pearl River Delta, starting from Shenzhen in the east and ending in Zhuhai in the west. It also links Dongguan, Guangzhou, Foshan, Jiangmen, Xinhui and Zhongshan. The total length of it is about 302 km. The construction of the Guangzhou-Shenzhen-Zhuhai expressway started in March, 1985. The total construction costs were estimated to be 3.8 billion RMB, or 559 million USD (Baidu Baike, 2010).

The Guangzhou-Shenzhen-Zhuhai expressway project is a 30-year build-operate-transfer (BOT) project. The Guangzhou-Shenzhen-Zhuhai Expressway Company is the special vehicle established to be in charge

⁸ The definition of asset based security is in the *List of Definition*.

⁹ The definition of asset based security is in the *List of Definition*.

of the building, operating and transferring of the Guangzhou-Shenzhen-Zhuhai expressway. And this company has the right to collect tolls during the operation phase and it should return the expressway assets back to Guangdong provincial government in 2027. The two largest sponsors are Hopewell Holding Limited (Hong Kong), and Guangdong Ministry of Transport. Hopewell Holding Limited owns 50% equity of the Guangzhou-Shenzhen-Zhuhai Expressway Company. In order to gather the funds for construction, the Guangzhou-Shenzhen-Zhuhai Expressway Company issued 600 million USD bonds using the underlying expressway assets or the tolling right from 1997 to 2027 as a guarantee (Mei and Li, 2004).

Finally, there are 17 public expressway companies in China now. Yue Expressway A (sz000429¹⁰), Yue Expressway B (sz200429), Hainan Expressway (sz000886), and HuaBei Expressway (sz000916) are listed in Shenzhen Stock Exchange. Wantong Expressway (sh600012), Zhongyuan Expressway (sh600020), Fujian Expressway (sh600033), Chutian Expressway (sh600035), Ganyue Expressway (sh600269), Shandong Expressway (sh600350), Ninghu Expressway (sh600377), and Shen Expressway (sh600548) are listed in Shanghai Stock Exchange. Chenyu Expressway (00107), Huning Expressway (00177), Shen Expressway (00548), Chinese Expressway Transmission (00658) and Wantong Expressway (00995) are listed in Hong Kong Stock Exchange (Sina Finance, 2011). These public companies gather money from people in stock IPO¹¹, further stock shares offering, asset based securitization¹², corporate bond issuance, and so on. The Ganyue Expressway Company is a good example of companies using almost all these financing methods, and we will discuss more details of it below.

The Ganyue Expressway Company

The Ganyue Expressway Company was established in March, 1998. Its principal sponsor is the Jiangxi Expressway Investment Company, which holds 51.98% of its total equity now. (Sina Finance, 2010) The financing activities of the Ganyue Expressway Company are illustrated in **Error! Reference source not found.**

¹⁰ sz000429 is the symbol for the stock Yue Expressway A. sz stands for stocks listed in the Shenzhen Stock Exchange. sh stands for stocks listed in the Shanghai Stock Exchange.

¹¹ The definition of stock IPO is listed in *List of Definition*.

¹² The definition of asset based securitization is in *List of Definition*.

Table 3-4 Financing Activity of Ganyue Expressway Company

Time	Financing methods	Scale of Financing	Purpose of Financing
April, 2000	stock IPO, 120 million new shares	194.1 million	Construction investment for Changzhang Expressway
October,2002	10:3 stock placement	52.4 million	Construction investment for Changtai Expressway
April, 2005	Internal fund and bank loan	57.1 million	Purchased 30% equity of Changzhang Expressway
April, 2005	Internal fund and bank loan	23.2 million	Purchased 30% equity of Changfu Expressway
November, 2005	Internal fund and bank loan	107 million	Purchased 36.67% equity of Changtai Expressway
October,2005	Short term bonds	147.1 million	Increased liquidity and change capital structure
June, 2006	Equity reform	570.6 million	Purchased Jiujin and Wenhou Expressway
September, 2006	Short term bonds	139.7 million	Increased liquidity and change capital structure

Source: Jiangxi Ganyue Expressway Company (江西赣粤高速公路股份有限公司, 2007). Exploring the capital market in expressway building (充分利用资本市场融资功能, 促进高速公路建设快速发展). Retrieved Nov. 2010 from www.jxexpressway.com

3.2.4. Aviation Industry in China

The Civil Aviation Administration of China, formerly the General Administration of Civil Aviation of China, is the aviation authority under the Ministry of Transport of the People's Republic of China. It oversees civil aviation and investigates aviation accidents and incidents (The Civil Aviation Administration of China, 2011). According to the statistics within the Civil Aviation Administration of China, the total infrastructure investments within the aviation industry was about 12 billion USD from 2001 to 2005, within which 3.28 billion came from the central government (The Civil Aviation Administration of China, 2006). The total infrastructure investment within the aviation industry was about 3.82 billion USD, 5.15 billion USD, 8.82 billion USD in 2006, 2007, 2008, 2009 respectively (The Civil Aviation Administration of China, 2007, 2008, 2009, 2010). This investment is estimated to reach 13.24 billion USD in 2010 (Chinese Foreign Investment Website, 2010).

In the case of the airports construction and operation financing, *Airport Location-Based Reform* is the most important reform, which transfers the responsibilities of building and operating airports from the central government to the provincial and municipal government. *Overview Of The State Industrial Policies In 1990s*, *Bill Of Civil Aviation System Reform*, *Reform Implementation Plan of Provincial (Autonomous Region's and Municipal) Civil Airports Management and Administrative System* are the three most important government laws related to this reform (Guangdong Airport Group, 2010). However, the central government does still participate in the building of civil airports by using the Civil Aviation Infrastructure Building Fund, which is collected from domestic airlines companies (10% percent revenue of the domestic routes and 4-6% revenue of the international routes) (Ministry of Finance, China, 1996).

Before the *The Reform And Open Policy* in 1978, the civil aviation industry in China was highly monopolized and was a part of the Chinese government. At that time, there was no distinction between military and civil airport. No independent civil airports existed at that time. At the end of 1980s, the aviation industry started its market-based reform and tried to separate airline companies, airports and aviation administration, which provided important prerequisite for the independence of airport industry. In October 1988, the responsibility of investing and operating Xiamen airport was transferred to Xiamen municipal government, which was an important milestone since it was the formal start of *Airport Location-based Reform*. In 1994, the responsibility of investing and operating Shanghai Hongqiao airport was transferred to Shanghai Government, which meant the *Airport Location-based Reform* had gained further support. *The policy Overview Of The State Industrial Policies In 1990s* issued in the late 1990s provided policy and legal foundation for local government capitals and other capitals to join the construction and operation of airports. In January 2002, the State Council passed the *Bill Of Civil Aviation System Reform*, and decided to implement the location- based reform in 129 civil airports expect for the Beijing Capital Airports and Airports in Tibet. In September 2003, the State Council published *Reform Implementation Plan of Provincial (Autonomous Region's and Municipal) Civil Airports Management and Administrative System*, which led to the national wide location-based reform. In July, 2004, after transferring the administration power of Lanzhou, Qingyang, Jiayuguan, and Dunhuang Airports to Gansu Provincial Government, *Airport Location-based Reform* officially finished (Guangdong Airport Group, 2010).

After this *Airport Location-based Reform*, most provinces and autonomous regions in China established their provincial airport groups which were in charge of the building and operating of civil airports within the provinces. These provincial airport groups are almost 100% owned by the provincial governments. If one needs to build an airport or enlarge a former airport, these provincial airport groups will establish a

new airport company as a special vehicle. And these provincial airport groups may provide money (or we can say the provinces will provide money) in the form of equity, help the new airport company borrow money from local banks and foreign banks, and issue bonds and stocks in the market.

If airports have good prospects of profitability, stock IPO is usually a good choice for financing the construction. Up to 2010, Shanghai Airport Company, Shenzhen Airport Company, Guangzhou Baiyun Airport Company and Xiamen Airport Company are all public companies listed in the Stock Exchange in China.

For example, Shanghai International Airport Company was established on May 16th, 1997 with Shanghai Airport Group being the only sponsor. The Shanghai International Airport Company is in charge of all the operating, building, and refinancing issue of the Pudong International Airport and the Hongqiao International Airport (QQ Finance, 2010). The funds for the first construction phase of the Pudong International Airport come from funds of the Shanghai government, loans from foreign governments, loans from the China Development Bank, stock IPO and convertible bonds (CITIC Securities, 2003).

3.2.5. Difference between Financing HSR and Other Transportation Projects in China

In this chapter, we can conclude that the financing of HSR and the financing of conventional railway projects are almost the same. The financing of HSR and the financing of expressway projects differ in the case that HSR projects are funded primarily by the bond issued by the MOR, while expressway projects have some dedicated fund source, such as vehicle purchase tax and fees. On the other hand, PPP, ABS and stock IPO are widely used for financing other expressway projects, and are seldom used for financing HSR and other conventional projects. The financing HSR and the financing of airport projects differ in the case that HSR projects are financed primarily by the central government and airport projects are financed primarily by provincial governments. Stock IPO is a feasible financing method for airport construction but is rarely used in HSR financing. The difference between financing HSR and other transportation projects in China is illustrated in Table 3-5.

Table 3-5 Difference In Financing---China

China	Procurement Method	% Of Private Capital ¹³	Principal Funding Source	Principal Funding Agency	Stock IPO	Other Innovative Financing Method
HSR projects	Traditional procurement method ¹⁴	Low	Bond Issued by MOR, provincial government funds, local bank loan	The central government & provincial governments	Never used	NA
Other railway projects	Traditional procurement method	Low	Bond Issued by MOR, provincial government funds, local bank loan	The central government & provincial governments	Seldom used	NA
Road projects	Traditional procurement method & PPP	Medium or high	Dedicated revenue, state bonds, stock IPO, domestic investment and foreign investment	The central government & private agencies	Widely used	ABS
Airport projects	Traditional procurement method	Medium	Provincial budget, local bank loan, special vehicle bond, stock IPO	Provincial governments	Widely used	NA
Urban transportation projects	NA ¹⁵	NA	NA	NA	NA	NA

Source: summarized by the author

¹³ Here we define private capital as funds raised independently by private companies without the help or guarantee from governments. This may include equity fund from private parent companies, loan or bond capital without government guarantees, and stock IPO capital without government guarantees and so on in PPP. This may only include equity fund from private companies if the project is built using the traditional procurement method.

¹⁴ Traditional procurement method is opposite to PPPs, which means government is responsible for building, financing, operating, and maintaining the infrastructure by itself. This definition is also in *List of Definition*.

¹⁵ Not available

3.3 Germany

3.3.1. Overview of Germany's Funding Sources for Transportation Projects

Germany relies mostly on the general public budgets to finance its transportation infrastructure projects, with private capital seldom taking part in this field. In Germany, Public Private Partnership (PPP) has only been used in building two tunnels (the Warnow Tunnel and the Herren Tunnel), and some ports in the past, although a multi-modal transportation infrastructure financing agency, VFIG (Verkehrsinfrastrukturfinanzierungsgesellschaft) was established in 2003 based on the Verkehrsinfrastrukturfinanzierungsgesellschaftsgesetzes (VIFGG) (transportation infrastructure financing agency law) to facilitate the use of PPPs (Astrid Güneman, 2005).

3.3.2. Road System in Germany

The federal government has the financial sovereignty in the investment decisions of federal roads and truck roads, and theoretically, the federal government should also be responsible for the project planning, construction and operation. The reality is the federal states are the direct performers who carry out the project planning, construction and operation on behalf of the federal government through their administrative bodies, while the federal government is responsible for controlling and giving instructions to the federal states.

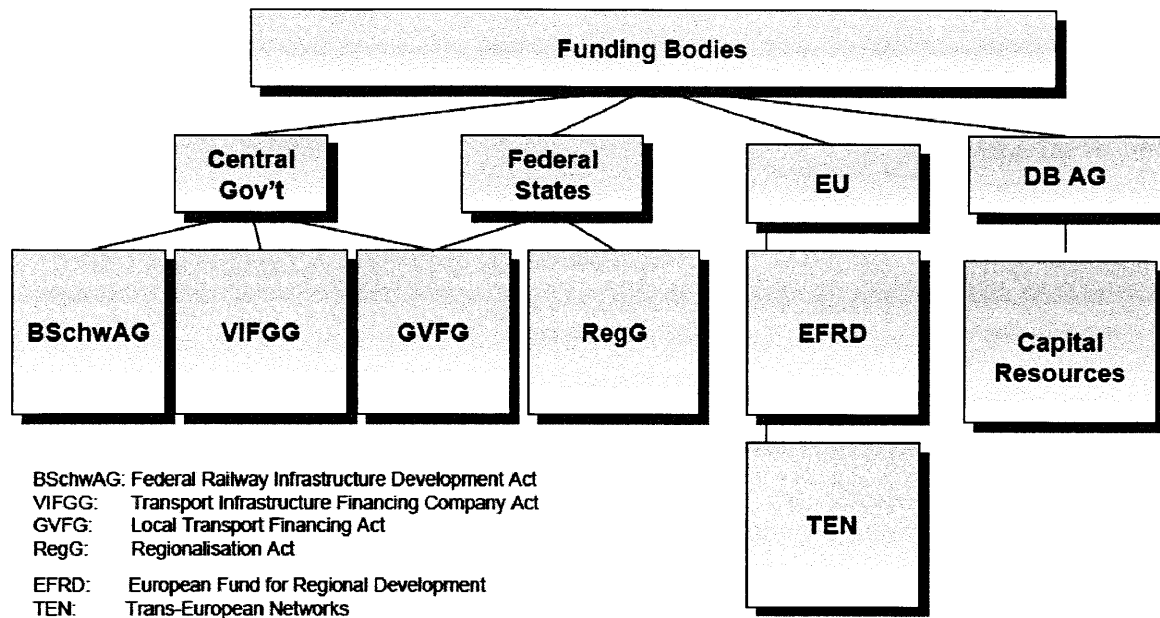
3.3.3. Railway System in Germany

As to national railway infrastructure projects, investments decision are made jointly by the federal government and the infrastructure company of the German railways, the DB Netz AG, although the DB Netz AG is still 100% state owned. Funding of rail infrastructures in Germany, with no exception for High-Speed Rail, comes from four parts: the federal government, the federal states, EU funds, and private capital of the DB Netz AG, which is shown in Figure 3-3. (Astrid Güneman, 2005) One reason that Germany gets EU funds, especially EU TEN-T funds, is that the German railway system, including its HSR system, is connected with other countries in the TEN-T network.

Fund provided by the federal government and the federal states is in the form of either subsidies or interest-rate free loan, while fund provided by the DB Netz AG is in the form of equity. The DB Netz AG is primarily responsible for ensuring the provision and operation of HSR infrastructure to a suitable level

of quality. Interestingly, the fund provided by the federal states actually comes from the federal government in the form of specific program subsidies, which will be illustrated in more detail in the following case study of HSR Stuttgart 21.

Figure 3-3 Funding Structure of German Railway System



Source: DB Netz AG (2006). Case Study: Germany. Workshop: Multi-Annual Contracts governing the Financing of Rail Infrastructure Maintenance. Retrieved Nov, 2010 from <http://ec.europa.eu/transport/rail/ws/doc/case-study-germany.pdf>

A major point of criticism for this system is that the track and train operating companies are under the auspices of the DB AG. This may tend to favor investment decisions which would primarily benefit DB AG transportation services (Astrid Güneman, 2005).

3.3.4. Inland Waterways and Airports in Germany

Inland waterways are invested and administrated by the federal government. Airports are owned and planned, regulated, funded by the federal states and local communities. Refunding of investments in inland waterways is partly through tolls and fees (e.g. for using locks), and refunding of airport investments is primarily through user costs (landing charges etc.) and airport services (rents from retail etc.) (Astrid Güneman, 2005).

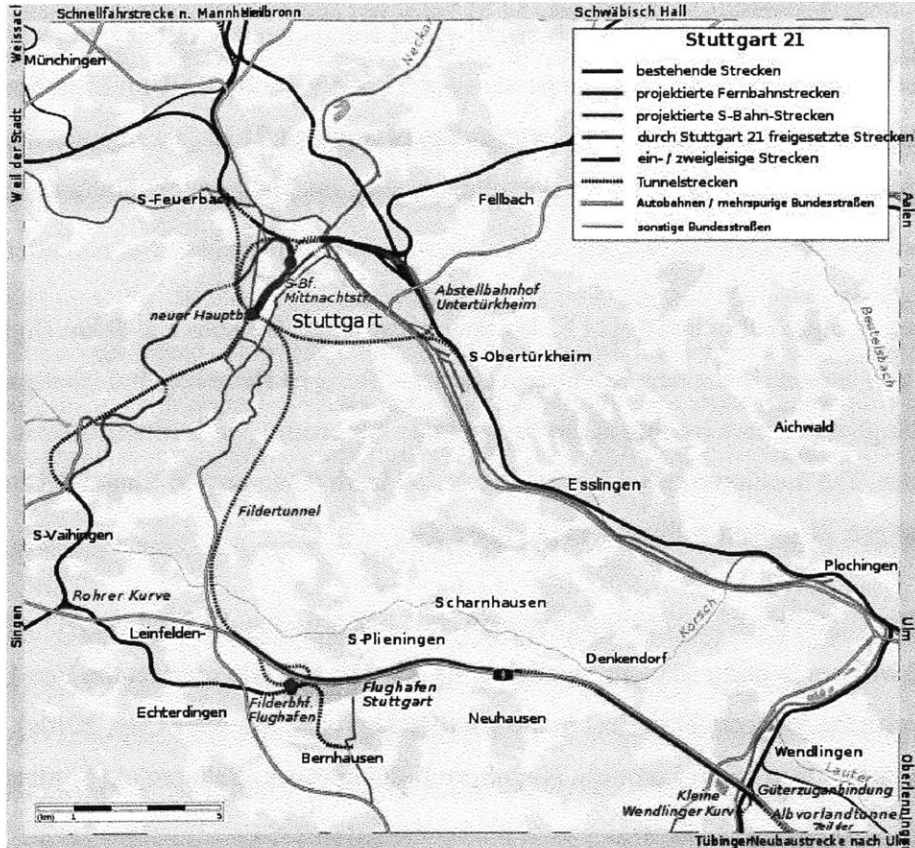
3.3.5. Stuttgart Ulm Rail Project (HSR Project)

The Stuttgart-Ulm rail project is one of the most innovative and comprehensive railway projects in Europe. This project includes two project segments: Stuttgart 21 and Wendlingen-Ulm High-Speed Railline. 4.088 billion Euros are required for the construction of Stuttgart 21 project segment and 2 billion Euros are required to build the ICE line between Wendlingen and Ulm (Bahnprojekt Stuttgart-Ulm, 2010a).

The Stuttgart 21 project, a project of building a 57 km new railway line, includes a 29.9 km High-Speed Railline, and three new stations in the new Rosenstein district – Stuttgart Hauptbahnhof (Stuttgart Main Station), Bahnhof Flughafen/Messe (station at the airport/trade fair centre) and Mittnachtstrasse S-Bahn (rapid transit) stations. The maximum speed for this line is 250 km/h (Bahnprojekt Stuttgart-Ulm, 2010a). The map of this Stuttgart 21 project is illustrated in Figure 3-4.

The Wendlingen-Ulm High-Speed Railline is a proposed HSR line crossing the Swabian Alb with speeds up to 250 km/h and will run in many sections parallel to the A8. The line will connect the Neu-Ulm station in the east, with the Stuttgart 21 project in the west (Bahnprojekt Stuttgart-Ulm, 2010a). Moreover, it will link Baden-Württemberg to the European High-Speed Rail network (Bahnprojekt Stuttgart-Ulm, 2010a).

Figure 3-4 Stuttgart 21 Project



Source: Wikipedia. 2010. Stuttgart 21. Retrieved Nov, 2010 from http://en.wikipedia.org/wiki/Stuttgart_21

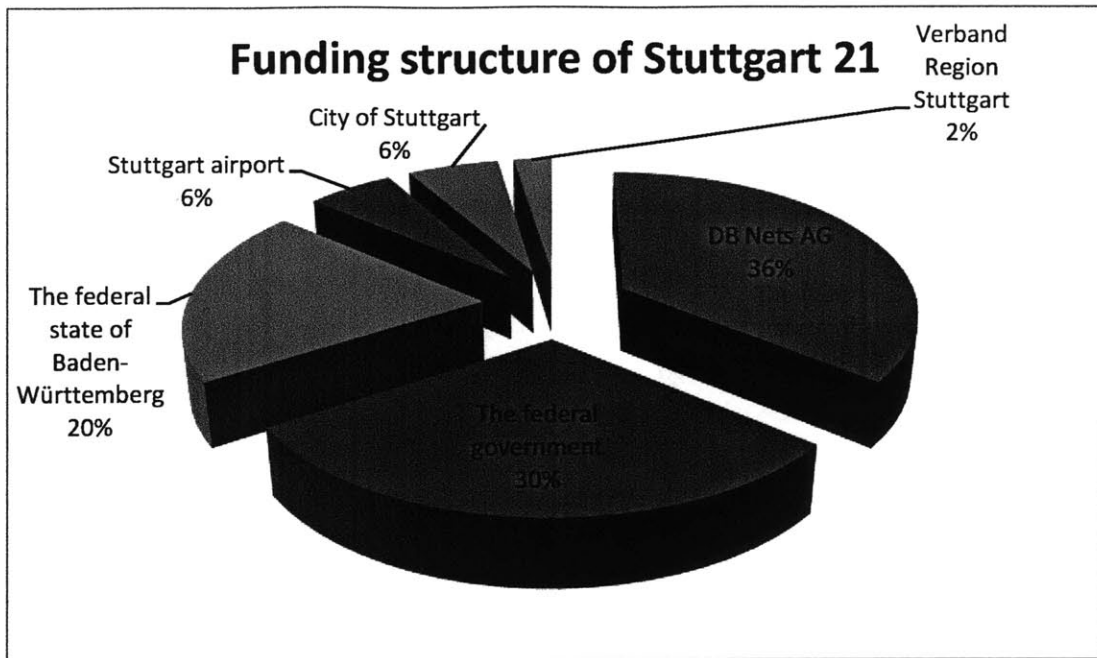
Funding of project segment Stuttgart 21

The 4.088 billion Euro construction costs of the Stuttgart 21 project are provided by (Bahnprojekt Stuttgart-Ulm, 2010b):

- 1.469 billion Euros come from the DB Nets AG;
 - 1.237 billion Euros the DB AG own fund
 - 232 million Euros risk fund
- 1.229 billion Euros come from the federal government;
- 824 million Euros come from the federal state of Baden-Württemberg;
- 227 million Euros come from Stuttgart airport;
- 239 million Euros come from City of Stuttgart;
- 100 million Euros come from Verband Region Stuttgart.

The funding structure of the Stuttgart 21 project is illustrated in Figure 3-5.

Figure 3-5 Funding Structure of Stuttgart 21



Source: Bahnprojekt Stuttgart-Ulm (2010b). FACTS & FIGURES. Retrieved Nov, 2010 from <http://www.das-neue-herz-europas.de/en-gb/facts--figures/default.aspx>

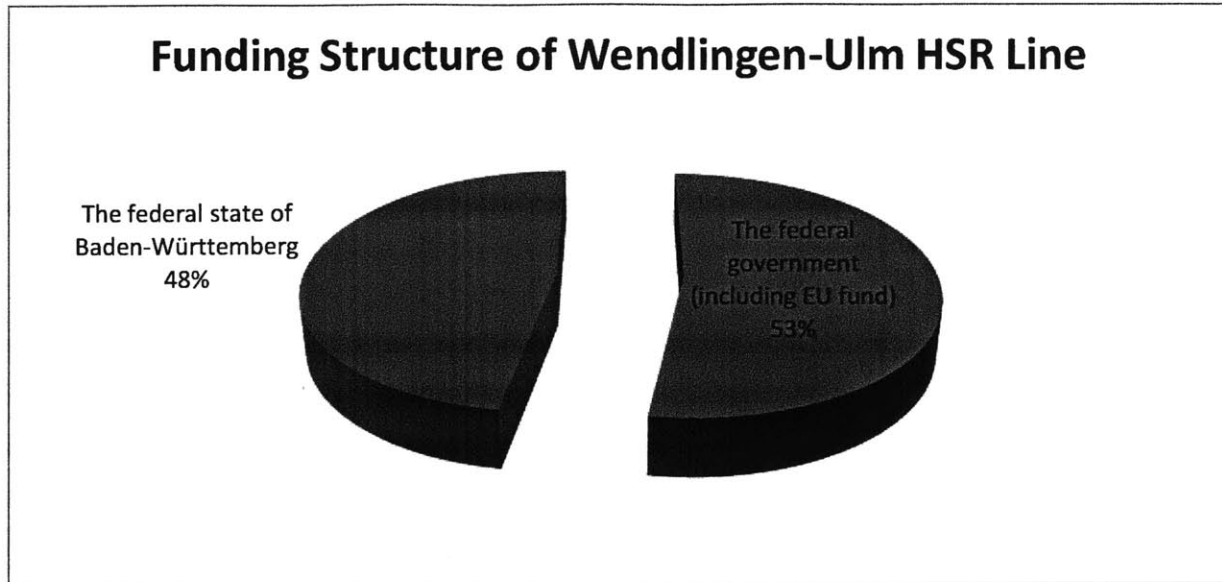
To make sure that the construction of the project progress well, an extra risk contingency fund of 1.45 billion Euros are provided as follows:

- First level, 220 million Euros provided by DB;
- Second level, 780 million Euros provided by the state, city and airport; (state (453.6 million Euros), city (206.9 million Euros) and airport (119.4 million Euros))
- Third level, 290 million Euros provided by DB;
- Fourth level, 160 million Euros provided by the state and city;

Funding of the Wendlingen-Ulm HSR Line (proposed)

The construction costs of the ICE line between Wendlingen and Ulm amount to 2 billion Euros. The federal government will assume a share of 1.05 billion Euros, including the funds provided by the EU. The federal state of Baden-Württemberg will provide the remaining 950 million Euros (Bahnprojekt Stuttgart-Ulm, 2010b). The funding structure of Wendlingen-Ulm HSR line is illustrated in Figure 3-6.

Figure 3-6 Funding Structure of Wendlingen-Ulm HSR Line



Source: Bahnprojekt Stuttgart-Ulm (2010b). FACTS & FIGURES. Retrieved Nov, 2010 from <http://www.das-neue-herz-europas.de/en-gb/facts--figures/default.aspx>

3.3.6. Difference between Financing HSR and Other Transportation Projects in Germany

In Germany, the federal government is responsible for financing federal roads and trunk roads, federal railways (including HSR), and inland waterways, while the states are responsible for the building of airports and sea ports. The general public budget is the main source of funding for transportation infrastructure investment.

High-Speed Rail projects, as one sub-category of federal railways, are financed in exactly the same way as other conventional railway projects do: they are financed by the federal government funds, the federal states funds, EU funds, and capital of the DB Netz AG together. Most of the federal roads and truck roads are financed directly by the federal government, while only two tunnels, Warnow Tunnel and Herren Tunnel, were financed by private capital using Public Private Partnerships. Inland waterways are solely financed by the federal government and airports are funded by the federal states and local communities (Astrid Güneman, 2005).

Therefore, we can conclude that in Germany, the HSR financing is the same as the financing other federal railway projects. The HSR project financing is similar to the federal road, inland waterway, and airport financing in the sense that public fund is the primary funding source for all these projects. However, HSR

projects are funded by the federal government and the federal states jointly, while federal roads are funded solely by the federal government and airports are funded solely by the federal states. In addition to these, private capital is provided by the DB Nets AG to finance all railway projects, which doesn't exist in other transportation modes. Difference between financing HSR and other transportation projects is illustrated in Table 3-6.

Table 3-6 Difference in Financing---Germany

Germany	Procurement Method	% Of Private Capital	Principal Funding Source	Principal Funding Agency	Stock IPO	Other Innovative Financing Method
HSR projects	Traditional procurement method	Low	The federal government fund, the federal states fund, EU funds, and capital of the DB Netz AG	The federal government, the federal state & the DB Netz AG	Never used	NA
Other railway projects	Traditional procurement method	Low	The federal government fund, the federal states fund, EU funds, and capital of the DB Netz AG	The federal government, the federal state & the DB Netz AG	Never used	NA
Road projects	Traditional procurement method & PPP	Low	The federal government fund, private capital, probably EU funds	The federal government	Never used	NA
Airport and seaport projects	Traditional procurement method	Low	The federal state fund	The federal state	Never used	NA
Urban transportation projects	NA	NA	NA	NA	NA	NA

Source: summarized by the author

3.4 Taiwan

3.4.1. Taiwan HSR Financing

As illustrated in Chapter 2, *Crowding Out Effect of HSR Investment*, built using BOT (one type of PPP), Taiwan High-Speed Rail (THSR) is a High-Speed Rail network that runs along the west coast of Taiwan with a total cost of 18 billion USD. (Taiwan High-Speed Rail, 2011) This THSR is isolated from other countries. The Taiwan High-Speed Rail Consortium (THSRC) was chosen as preferred bidder in September 1997 (I-Tsung Tsai, 2007), and the group was renamed and formally established as the Taiwan High-Speed Rail Corporation (THSRC) in May 1998. (Taiwan High-Speed Rail, 2011)

Financing THSR

The original capital investment for this THSR project was estimated to be 15 billion USD. 21% of the construction costs (3.1 billion USD) would be financed by the government, while the remaining 79% would be financed by private capital. Within the private capital, 69% was estimated to be debt, and 31% was estimated to be equity. Within the private equity, the 5 parent firms of THSRC were estimated to provide more than 51%, institutional investors were estimated to provide 29-34%, and the remaining 12%-20% was estimated to be raised from stock IPO in the local stock market (I-Tsung Tsai, 2007). The projected funding structure of THSR is illustrated in Figure 3-7.

However, the real funding structure turned out to be very different from the projected one. Until the end of 2006, the total construction cost became 16.5 billion USD. The real financing process of private capital could be divided into four stages:

The first stage ended in 1997. In this stage, sponsor companies provided 1.23 billion USD in the form of equity, Taiwan government provided 253 million USD in the form of equity, and 25 local banks provided a syndicated loan of 6.18 billion USD, which was guaranteed by a deposit of 6.18 billion USD postal bond from the Council for Economic Planning and Development in Taiwan government (I-Tsung Tsai, 2007).

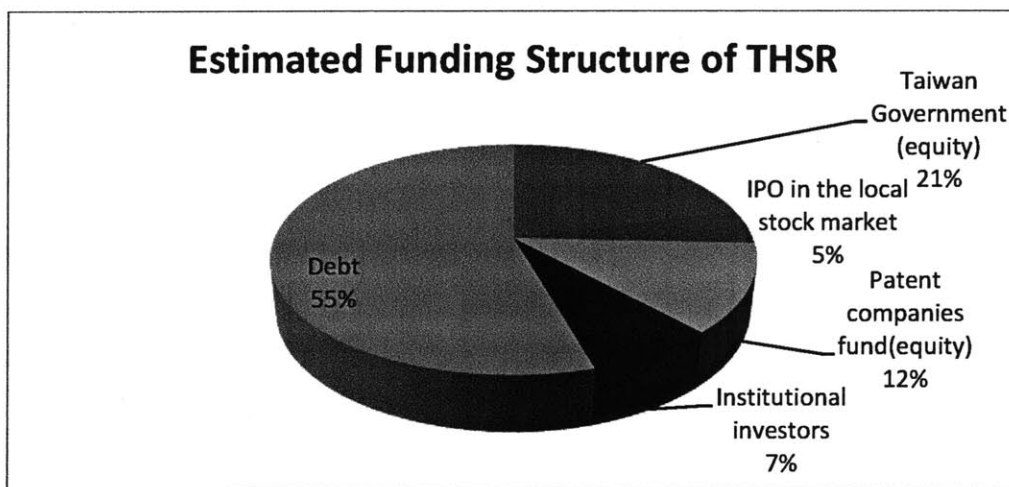
The second stage ended in 1999. In this stage, a syndicated loan of about 2.05 billion USD was provided by 25 local banks, which was guaranteed by a deposit of 882 million USD of postal bond from the Council for Economic Planning and Development in Taiwan government (I-Tsung Tsai, 2007).

The third stage was from Dec 2002 to May 2005. In this stage, 2.3 billion USD was collected from stock IPO for convertible and preferred stocks with tax incentives. The tax incentives were stated as: “For those entities/people who hold the stocks of domestic major transportation projects or significant infrastructures for more than two years, these entities/people can claim 20% of their investments as deductibles from taxable income, starting from year 2.” (I-Tsung Tsai, 2007)

The fourth stage was May 2005. In May 2005, THSRC reported a forecasted cost overrun of 1.5 billion USD. To cover these costs, 0.2 billion USD was provided by the Taiwan government in the form of equity and 1.3 billion USD was provided by local commercial banks in the form of loan without government fund back up (I-Tsung Tsai, 2007).

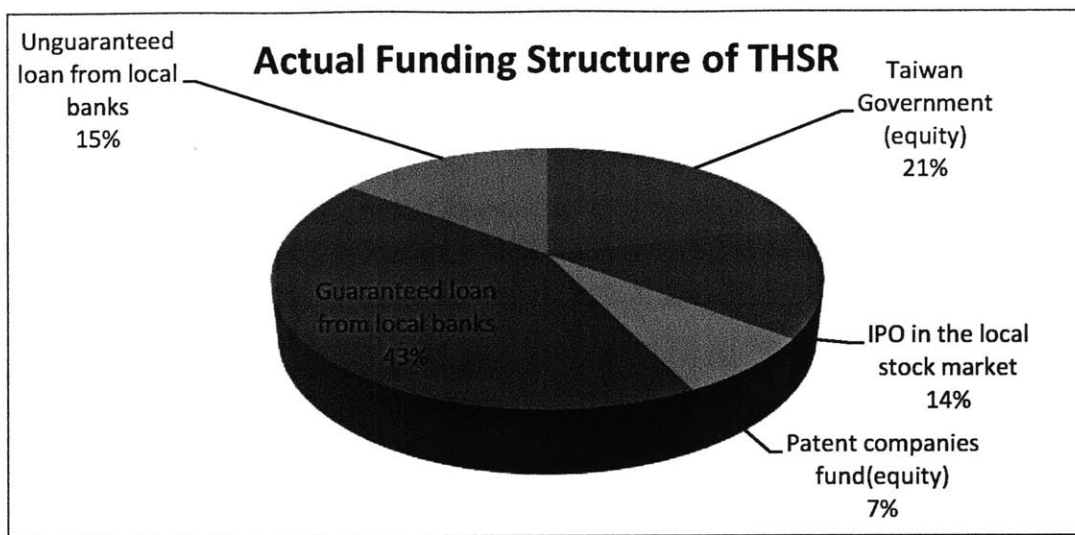
To sum up, up to the end of 2006, 16.5 billion USD was collected for the THSR construction. 7.083 billion USD was in the form of equity; within this equity financing, 3.553 billion USD was provided by the Taiwan Government, 2.3 billion USD came from stock IPO in the local stock market, and 1.23 billion USD was provided by the five patent companies. 9.53 billion USD was collected in the form of debt, within which, 2.468 billion USD came from syndicated loans from 25 local banks without the government guarantees, and the remaining 7.062 billion USD came from syndicated loans from 25 local banks guaranteed by a deposit of 7.062 billion USD postal bond from the Council for Economic Planning and Development in Taiwan government (I-Tsung Tsai, 2007). The actual funding structure of THSR is illustrated in Figure 3-8.

Figure 3-7 Projected Funding Structure of THSR



Source: I-Tsung Tsai (2007). *Default and Renegotiation: Financial Structure and Incentive in Public Private Partnership Contracts*. PhD Dissertation, MIT, Cambridge, MA.

Figure 3-8 Actual Funding Structure of THSR



Source: I-Tsung Tsai (2007). *Default and Renegotiation: Financial Structure and Incentive in Public Private Partnership Contracts*. PhD Dissertation, MIT, Cambridge, MA.

To understand the difference between financing HSR and other transportation projects, we need to take a look at the financing methods of other transportation projects, for example, public transit projects, seaport projects, airport projects and so on. The projects in the *i-Taiwan Infrastructure Projects* provide us good examples.

3.4.2. The i-Taiwan 12 project

In 2008, Taiwanese government has adapted *i-Taiwan Infrastructure Projects* as the means of the “new blueprint of economic development” to facilitate the transition and innovation in Taiwan’s economic fundamentals. The *i-Taiwan Infrastructure Projects* include: a fast and convenient island-wide transportation network, Taoyuan International Air City, “Intelligent Taiwan”, “Industrial Innovation Corridors”, urban and industrial zone renewal, green forestation, and so on. A total investment of NT\$3.99 trillion, or 132 billion USD is estimated to be raised for building infrastructure projects within 8 years (2008-2015), including NT\$ 2.65 trillion, or 87.7 billion USD via government budget and NT\$1.34 trillion, or 44.3 billion USD via private investment (Public Construction Commission, 2010). The funding structure of transportation projects in *i-Taiwan Infrastructure Projects* is illustrated in Table 3-7.

Table 3-7 Funding Structure of Transportation Projects in i-Taiwan 12 Projects

Item	Total Investment (NT\$ billions)	Private Investment (NT\$ billions)	Percentage Of Private Investment
A Fast and Convenient Transportation Network(mostly public transit)	1,215.70	76.3	6.28%
Kaohsiung Port-City Reconstruction	38.8	16.1	41.49%
Taoyuan International Airport City	293.7	64.4	21.93%

Source: Public Construction Commission (2010). I-Taiwan 12 projects. Retrieved Dec.2nd from

<http://ppp2.pcc.gov.tw/pcc/en/Introduction2.aspx>

3.4.3. Difference between Financing HSR and financing other transportation projects in Taiwan

It is surprising to see that in Taiwan: the government only provides 21% fund for HSR construction, while the government has to provide 94%, 78%, 58% fund for “A Fast and Convenient Transportation Network”, “Taoyuan International Airport City” and “Kaohsiung Port-City Reconstruction” respectively. However, we should also notice that, in HSR financing, 43% of the fund comes from a guaranteed loan guaranteed by a full amount deposit provided by Taiwan government. And 14% of the fund comes from stock IPO mostly due to the tax incentives. If we add both the full amount deposit and tax incentives as fund provided by the Taiwan government, 78% of fund comes from the government, which is almost the same as the airport project “Taoyuan International Airport City”. Difference between financing HSR and other transportation projects in Taiwan is illustrated in Table 3-8.

Table 3-8 Difference in Financing---Taiwan

Taiwan	Procurement Method	% Of Private Capital	Principal Funding Source	Principal Funding Agency	Stock IPO	Other Innovative Financing Method
HSR projects	PPP	Low or medium	The government fund, stock IPO, private capital and local bank loan	Taiwan government & private companies	Yes, but with tax incentive	No
Other railway projects	NA	NA	NA	NA	NA	NA
Road projects	NA	NA	NA	NA	NA	NA
Airport and seaport projects	PPP	Medium	The government fund, private capital	Taiwan government & private companies	NA	NA
Urban transportation projects	PPP	Low	The government fund, private capital	Taiwan government & private companies	NA	NA

Source: Summarized by the author

3.5 Portugal

3.5.1. Overview of Portugal’s Funding Sources for Transportation Projects

“Portugal has not established an explicit surface transportation policy and finance system. No overarching policy coordinates transportation activity and, apart from the revenue dedicated to road infrastructure, there is no explicitly defined transportation finance system.” (Nelson, 2008)

The funding of transportation investments in Portugal, including conventional rail investments, public transit investments, and airport and seaport investments come primarily from the central government of Portugal. And the central government funding comes from general revenues together with extremely limited streams of dedicated revenues. Municipalities do not utilize any form of dedicated revenue for transportation-related government expenditures. (Nelson, 2008)

Project planning and financing in Portugal is biased toward road infrastructure. Road planning is guided by a national road plan and road financing benefits from a dedicated revenue stream. Rail and public

transportation planning and financing, however, do not have equal plans or dedicated revenues. (Dunn, 2008)

Since 2005, the Portuguese national budget has authorized a stream of dedicated tax revenues, which is generated by the Circulation and Haulage Tax (Imposto de Circulação e Camoagem, ICI, ICA), for the national road authority, Estradas de Portugal (EP). Beyond this, no additional dedicated revenue sources exist. Other transportation investments except for road investments have to compete with all other public investments to draw funds from general tax revenues. The national budgeting cycle therefore features an extensive process of expenditure authorizations, as the various ministries of the central government compete with one another for funds. (Dunn, 2008)

Funds for transportation infrastructure investments, including conventional rail investments, public transit investments, and airport and seaport investments, are offered in three forms: (a) operating subsidies (indemnizações compensatorias) disbursed directly to state-owned SEE enterprises, (b) capital project grants transferred to SEE enterprises and municipal governments, and (c) EU Structural Funds earmarked for specific projects but administered by central government. Municipal governments provide operating and capital funds for municipal transportation departments and in-house public transit systems where they exist. (Nelson, 2008)

Private capital is allowed to take part in road infrastructure construction and maintenance, but its involvement in rail and urban transportation has been largely limited. (Nelson, 2008)

3.5.2. Road System in Portugal

In 1972, the first concession for a tolled motorway was granted with the creation of the private company Brisa. After the 1974 Carnation Revolution, the government took majority equity of Brisa, making it a state-owned enterprise. Until the 1990s, Brisa was the sole motorway concessionaire in Portugal. During this decade, the Portuguese government decided to privatize Brisa and increase the number of private companies participating in road infrastructure concessions to promote competition and industry development (Dunn, 2008).

Since then, the Portuguese government has used PPPs extensively to develop and manage its National Motorway System. There are two reasons for Portugal to widely use PPPs mechanism in its intercity road

development: one is in the strong road demand and the other is the public budget constraint due to the European Union(EU)’s Convergence Criteria (FHWA, 2009).

Up to 2007, the length of the Portuguese intercity road network under PPPs mechanism is approximately 2529 km, which accounts for almost 70% of the total length of Portuguese intercity road network (approximately 3546 km). Therefore, we can conclude that most Portuguese intercity roads were built under PPPs (Nelson, 2008). In most of these road projects, a substantial part of the initial funding is provided by the EU and – as in the case of SCUT – the European Investment Bank (EIB) (Renda and Schrefler, 2006). The Beiras Litoral / Alta shadow toll road or SCUT project is a good example to illustrate the financing methods of road projects in Portugal because of the use of PPPs and the substantial part of EU funding or EIB loans in this project.

The Beiras Litoral / Alta Shadow Toll Road or SCUT project

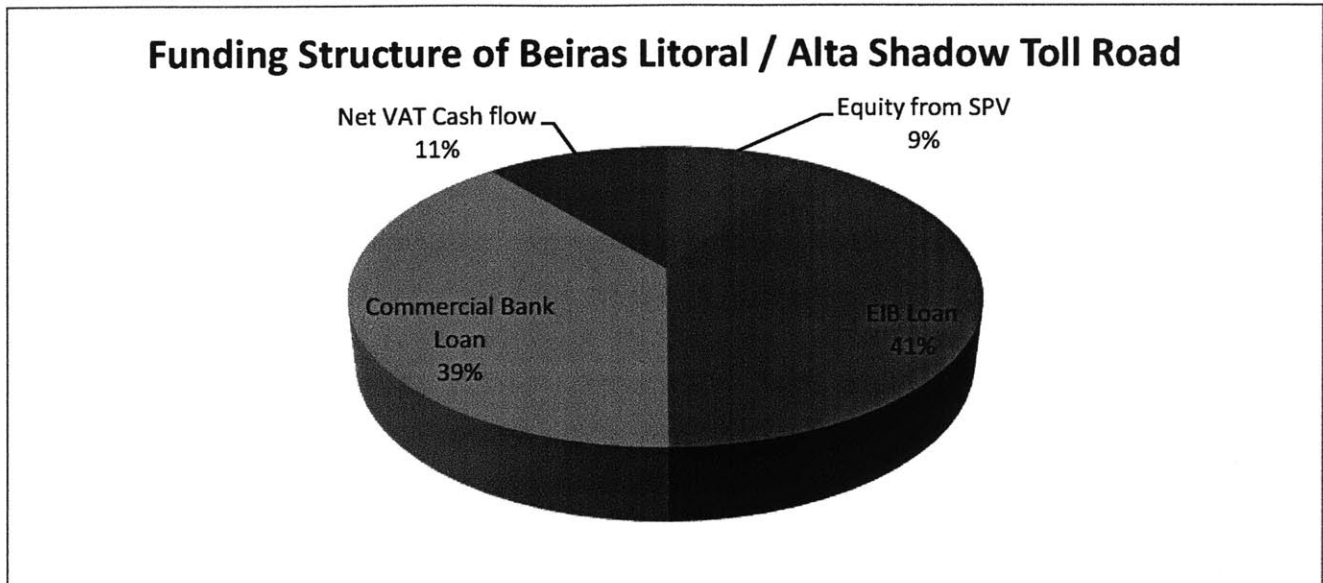
The Beiras Litoral / Alta Shadow Toll Road or SCUT project entails the widening and upgrading of 167 km of the existing two-lane (2x1) IP5 road between Aveiro, in the Coastal West, and the Spanish border at Vilar Formoso (East), via the cities of Viseu and Guarda (European Commission, 2004). The project is a Design-Build- Operate-Transfer (DBOT) project. Revenues for the project company (Lusoscut consortium) are granted by a shadow toll system (Renda and Schrefler, 2006). The financing structure of Beiras Litoral / Alta shadow toll road is illustrated in Table 3-9 and Figure 3-9:

Table 3-9 Funding Structure of the Beiras Litoral / Alta Shadow Toll Road

Use of funds	EUR (Million)	Percentage	Sources of funds	EUR (Million)	Percentage
Construction costs	693.4	60.5	Equity from SPV	102	8.9
Start-up costs	75.5	6.5	EIB loan	470	41
Financing costs	164.9	14.4	Commercial bank loan	448.4	39.1
Other start-up costs (incl. fees and reserves)	51.5	4.5	Net VAT cash flow	126.2	11
VAT, working capital build-up and operating cash flow	161.3	14.1			
Total	1146.6	100		1146.6	100

Source: European Commission (2004). *Resource Book On PPP Case Studies*. Retrieved Nov 2010 from http://ec.europa.eu/regional_policy/sources/docgener/guides/pppresourcebook.pdf

Figure 3-9 Funding Structure of Beiras Litoral / Alta Shadow Toll Road



Source: European Commission (2004). *Resource Book On PPP Case Studies*. Retrieved Nov 2010 from http://ec.europa.eu/regional_policy/sources/docgener/guides/pppresourcebook.pdf

The commercial bank loan has a maturity of over 25 years, and it is structured as a non-recourse loan¹⁶, with repayment entirely dependent on the SPV’s revenue performance according to the level of motorway usage and the resulting revenue stream. The loan from the EIB has a slightly longer maturity of 27 years and is guaranteed by a commercial bank syndicate. The EIB loan has a possibility of guarantee release during the loan life – 50% after year 8 and 50% after year 16 (European Commission, 2004).

3.5.3. The Poceirao-Caia High-Speed Rail

As the first HSR project in Portugal, the Poceirao-Caia High-Speed Rail project is built using Design, Build, Finance, and Maintain mechanism, one of the PPP mechanisms. The total length of this HSR line is 165km. The concession period of this project is 40 years. The PPP project company (concessionaire) will receive payment from the Portuguese government based on availability (75%), maintenance (25%) and demand (+2%). The total construction investment for this HSR project is about 1.359 billion Euros

¹⁶ The definition of non-recourse loan is in *List of Definition*.

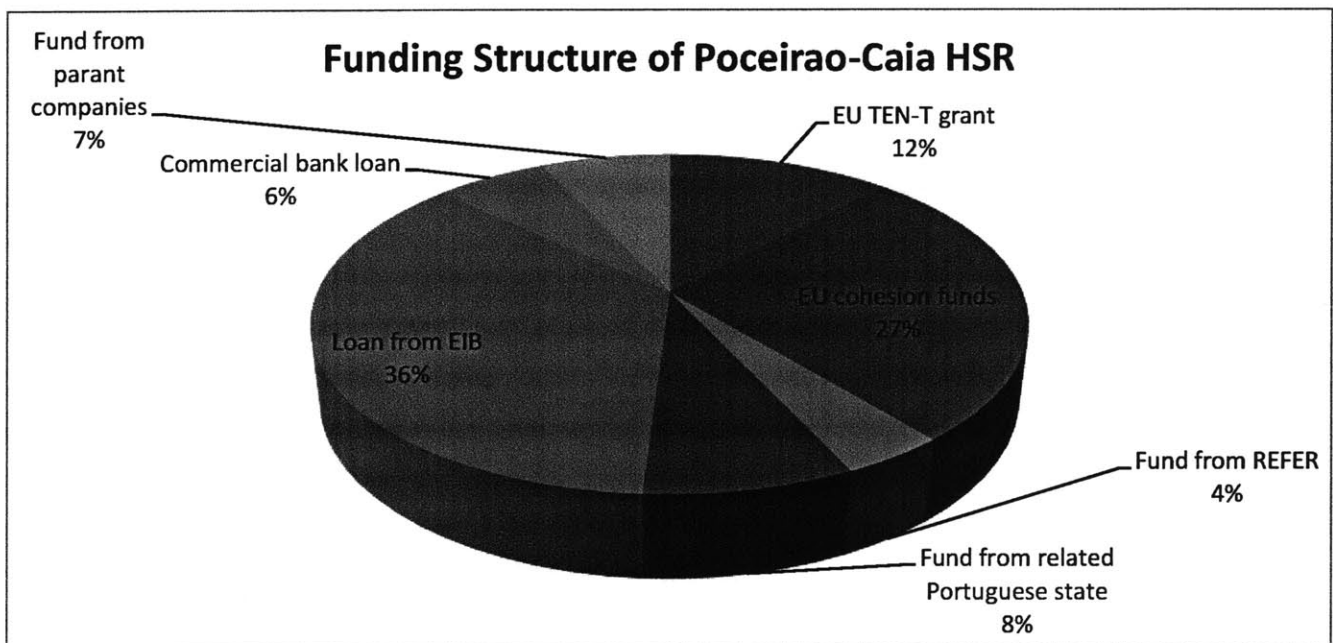
and the life cycle costs of this project are 1.814 billion Euros when discounting all the cash flow back to 2008 (RAVE, 2010B). The map of the Poceirao-Caia HSR project is shown in Figure 3-10. The financial structure of the Poceirao-Caia HSR project is illustrated in Figure 3-11.

Figure 3-10 Map of the Poceirao-Caia High-Speed Rail



Source: ENR (Official Website). 2011. Retrieved May, 2011 from <http://enr.construction.com/images2/2010/06/0602-15a.jpg>

Figure 3-11 Funding Structure of the Poceirao-Caia HSR



Source: 1. RAVE. 2010. The Portuguese High-Speed Rail Project. Application of Life-Cycle Contracts in High-Speed Rail Projects Conference. Moscow, Portugal. April, 2010. 2. Millennium BCP. 2010. Poceirão-Caia HS Project Financing. Workshop on PPP and High-Speed Rail. Lisbon, Portugal. January. 2010.

EIB provides a 300 million guaranteed loan and a 300 million unguaranteed loan to this providing, both with a maturity of 34 years. The 300 million guaranteed loan from EIB is guaranteed by the Portuguese government. In addition to that, the SPV issues a performance bond valuing 5% of the Contractual Price (84.559 million Euros) maturing one year after the concession end. Commercial Banks provide a 27 year long term loan valuing 91 million Euros (Millennium BCP, 2010). One of the reasons that this Poceirao-Caia HSR project can receive EU funding and EIB loans is that this project is part of the EU TEN-T railway network and contribute the prosperity of all the EU.

3.5.4. Difference between financing HSR and other transportation projects in Portugal

In Portugal, most transportation modes, including conventional rail, public transportation and airport and seaport projects are built using the traditional procurement method and funded mostly by the central government of Portugal. The only two exceptions, HSR and most intercity road projects, are built using PPPs and are allowed to attract private capital. In addition, the Portuguese HSR projects investments rely more heavily on EU grants or EIB loans, and are able to attract less private capital than the road projects do. For example, for the Poceirao-Caia HSR project, 75% fund comes from EU grants and EIB loans, only 7% fund comes from the private capital (from the private sector); for the Beiras Litoral / Alta Shadow Toll Road or SCUT project, 41% fund comes from EIB loans, and 48% fund comes from the private capital (both from commercial bank loan without government guarantees and from the private sector). Difference between financing HSR and other transportation projects is illustrated in Table 3-10.

Table 3-10 Difference in Financing---Portugal

Portugal	Procurement Method	% Of Private Capital	Principal Funding Source	Principal Funding Agency	Stock IPO	Other Innovative Financing Method
HSR projects ¹⁷	PPP	Low or medium	The government fund, EU funds, EIB loan, commercial bank loans	The central government & private companies	No	No
Other railway projects	Traditional procurement method	Low	The government fund, EU funds and probably local bank loan	The central government	NA	NA
Road projects	PPP	Medium or high	EIB loan and local bank loans	The central government & private companies	NA	NA
Airport and seaport projects	Traditional procurement method	Low	The government fund, EU funds and probably local bank loan	The central government	NA	NA
Urban transportation projects	Traditional procurement method	Low	The government fund, EU funds and probably local bank loan	The central government	NA	NA

Source: summarized by the author

3.6 Japan

3.6.1. Overview of Japan's Transportation Investment

As illustrated in Chapter 2, *Crowding Out Effect of HSR Investment*, Japan has a very modern transportation system, including all road, railway, airport and urban transportation projects. We will discuss these different transportation modes in more detail below.

¹⁷ This data is only based on the Poceirao-Caia High-Speed Rail, the only HSR project in Portugal right now (in construction or in operation).

3.6.2. Road System in Japan

By the end of 2008, Japan has approximately 1,203,600 km roads consisting of 7,600 km national expressways, 55,000 km general national roads, 129,000 km prefectural roads, and 1,012,000 km city, town and village roads. (Ministry of Internal Affairs and Communications (Japan), 2011) In addition, Japan has a high-speed and limited-access toll road network connecting major cities on Honshū, Shikoku and Kyūshū, and toll is an important funding source for the Japanese road.

At the beginning, Japan typically financed its road building by issuing road bonds and collecting tolls during operations to pay back bonds. The Japan Road Public Corporation, founded in 1956, was established to construct and manage the road network in Japan. Considering the fact that some rarely used roads may not generate enough revenues to cover their operating and financing cost, all tolls were pooled together to cover the operating costs, and interest and principal payments of the government road debts of the whole road network. (Sakamoto, Personal communication, Jan 17, 2011)

Now, the government gave up this scheme and it finances its new road building using dedicated tax revenues, such as car taxes and gas taxes. (Sakamoto, Personal communication, Jan 17, 2011)

3.6.3. Railway System in Japan

In Japan, railways are a major means of passenger transportation, especially for high-speed transportation between major cities and for commuter transportation in metropolitan areas. Seven Japan Railways Group companies are the most important participants in both the local and regional railway market. (Wikipedia, 2011f) The Japan National Railway (JNR) privatization is a milestone event in the history of the Japanese HSR finances: HSR projects are all financed by public capitals before this privatization and partly financed by private capitals after this privatization. At the same time, analysis of the financing of other railway projects should be conducted case by case: some profitable projects are financed by both private and public capitals, and other unprofitable projects are financed by public capitals only. (Sakamoto, Personal communication, Jan 17, 2011)

HSR in Japan

The Shinkansen is a HSR network in Japan. Starting with the 210 km/h (130 mph) Tōkaidō Shinkansen in 1964, the now 2,452 km (1,524 mi) network has expanded to link most major cities on the islands of Honshū and Kyūshū at speeds up to 300 km/h (186 mph). (Melibaeva, Sussman, and Dunn. 2010) The

Japanese Shinkansen network is well connected within Japan, but isolated from other countries by the Pacific Ocean.

In 1987, Japanese National Railway was privatized, with its business succeeded by seven JR companies and some corporations. This is one of the most important events in Japanese HSR history and HSR financing differs before and after JNR privatization.

Three HSR lines were built before JNR privatization: Tokaido-line (1964), Sanyo-line (1975) and Tohoku-line and Joetuu-line (1982). These HSR lines were built by the Japan Railway Construction Public Corporation (JRCPC) in represent of the government. This JRCPC was created by the government to be in charge of HSR construction only and the construction fund was provided solely by the Japanese government (the government gets the money partly from world bank loans and partly from issuing national bonds to the domestic market). After finishing their construction, these HSR line infrastructures were bought by JNR from the government. However, JNR didn't have enough money so that it had to borrow money from the Japanese government. It turned out that JNR bought the HSR line infrastructures from the government with the money borrowed from the Japanese government. (Sakamoto, Personal communication, Jan 17, 2011)

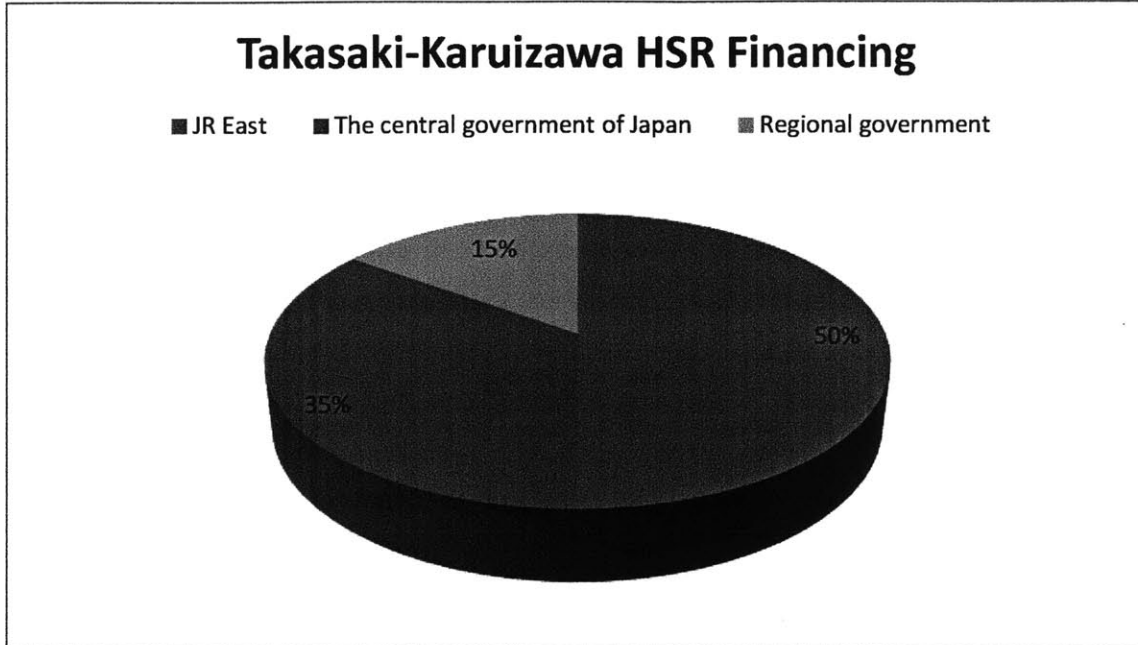
In the first three years after JNR privatization, The HSR Retention Organization was created to hold both HSR infrastructures and debts of JNR. The three main JRs, JR East, JR West and JR Central paid usage fees for using the infrastructures. Three years after privatization, the three main JRs bought out these HSR infrastructures from the Japanese government with the prices calculated based on each HSR's profitability, not on their original construction costs. The price turned out to be 46 billion USD¹⁸ for the Tokaido-line, 8.8 billion USD for the Sanyo-line, and 28 billion USD for the Tohoku and Joetuu-line. (Sakamoto, Personal communication, Jan 17, 2011)

After JNR privatization, three new HSR lines were built: the Takasaki-Karuizawa line, the Hokuriku-line and the extensional Tohoku-line. The Takasaki-Karuizawa line was built by tax revenue of the central

¹⁸ Here the exchange rate is 1 USD= 110 JPY in 1991

government of Japan (35%), tax revenue of regional governments (15%) and the private capital of JR East (50%). The funding structure of the Takasaki-Karuizawa line is illustrated in Figure 3-12.

Figure 3-12 Takasaki-Karuizawa HSR Financing



Source: Sakamoto, Personal communication, Jan 17, 2011

The Hokuriku-line and the extensional Tohoku-line were built by the central government of Japan and regional governments only. JR East paid usage fee for using these new HSR infrastructures. The construction funds of these two lines were all public funds and could be divided into four parts: the usage fees paid by JR East, which was estimated to be 78 million USD; the money gained from selling the Tokaido-line, the Sanyo-line, and the Tohoku and Joetu-line; taxes from the central government of Japan; and taxes from regional governments. (Sakamoto, Personal communication, Jan 17, 2011)

It should be noted that the three biggest HSR companies: the JR-East, Central and West, are all public companies listed in the Tokyo stock exchange. The most important assets of the three JR companies are the Tokaido-line, the Sanyo-line, and the Tohoku and Joetu-line, which have all demonstrated their abilities to generate profits. This means if the underlying HSR assets can generate enough profits, the stock market is a feasible source to gather money for HSR companies. (Sakamoto, Personal communication, Jan 17, 2011)

Other railway projects in Japan

Analysis of other railway project (non-HSR) financing should be conducted on a case by case basis. To separately show how local railways and intercity conventional railways are financed, we will discuss two cases below: the Tohoku-Jukan line, a JR East's new local railway, and Tukuba New Express, a new line from Tukuba city to Tokyo megalopolis.

Tohoku-Juhkan Line

The construction cost of Tohoku-Juhkan-line is about 0.4 billion¹⁹, and it is fully financed by the private capital from JR East.

Tukuba New Express

Tukuba-new express, a new line running from the Tukuba-city to the Tokyo metropolitan area, is managed by the Metropolitan Intercity Railway Company, MIR. (Sakamoto, Personal communication, Jan 17, 2011) The funding source for this project is stated in Table 3-11 and Figure 3-13 below.

Table 3-11 The Tukuba New Express Financing

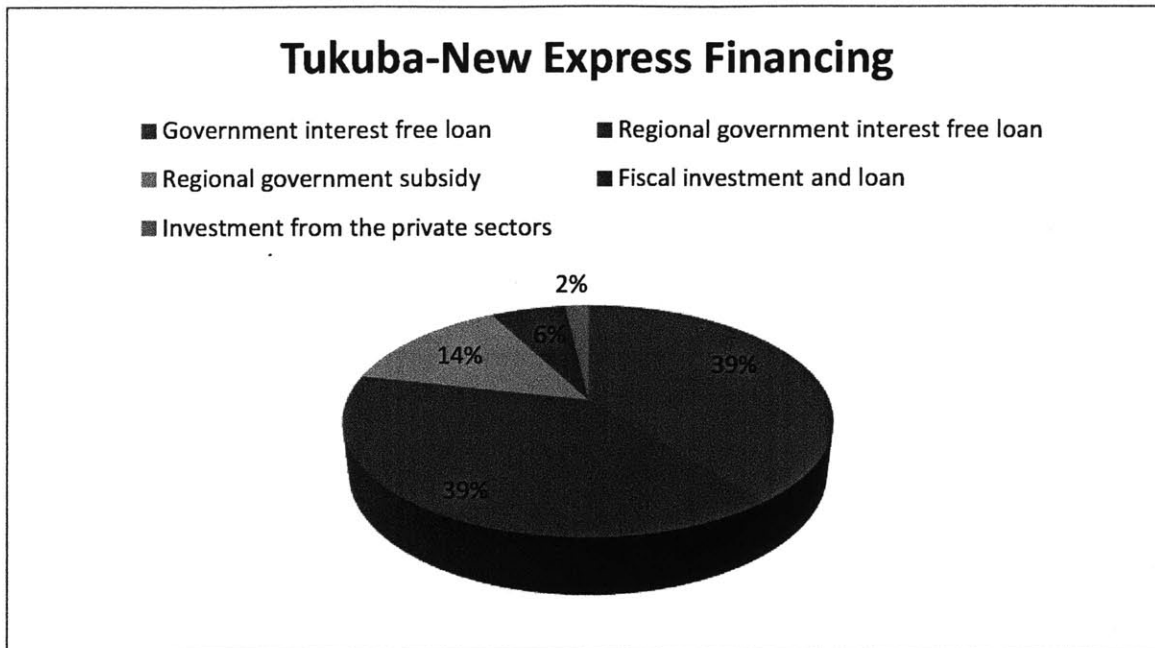
Funding source	Amount(million USD20)
Government interest free loan	4113
Regional government interest free loan	4113
Regional government subsidy	1440
Fiscal investment and loan	617
Investment from the private sector	190

Source: Sakamoto, Personal communication, Jan 17, 2011

¹⁹ Here the exchange rate is 1 USD= 100 JPY

²⁰ Here the exchange rate is 1 USD= 100 JPY

Figure 3-13 Tukuba New Express Financing



Source: Sakamoto, Personal communication, Jan 17, 2011

3.6.4. Civil Aviation System in Japan

Japan has 97 airports in 2010. (Wikipedia, 2011f) The Narita International Airport, Kansai International Airport, and Chūbu Centrair International Airport are all important international gateway airports. And the Tokyo International Airport is an important domestic airport hub. (Wikipedia, 2011f)

Almost all old and regional airports were invested by the central government and regional government. However, private capital is becoming more and more interested in this industry after the building of the Kansai airport. A typical example of this is the Chūbu Centrair International Airport. (Sakamoto, Personal communication, Jan 17, 2011)

The Chūbu Centrair International Airport

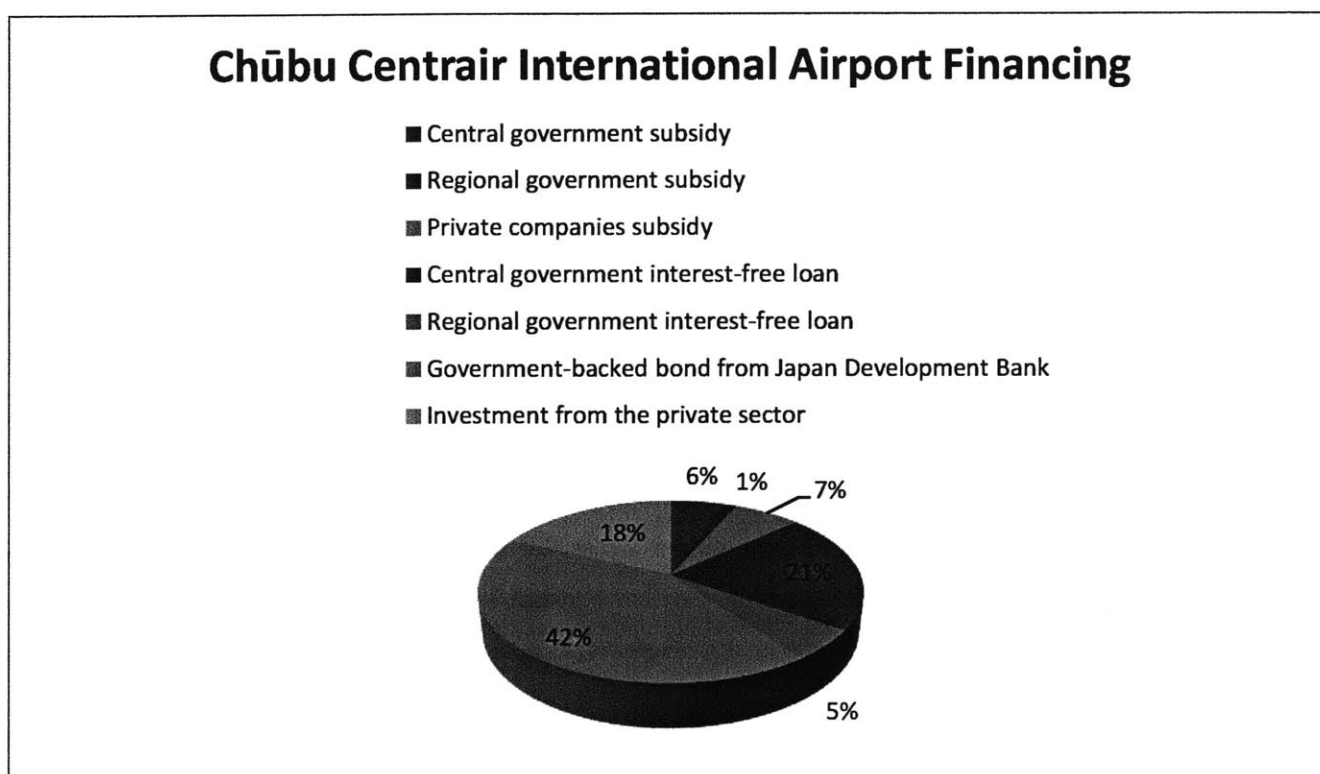
The Chūbu Centrair International Airport is located in the Tokoname city in Aichi Prefecture. It is “Japan’s third off-shore airport, after Nagasaki Airport and Kansai International Airport, and is also the second airport built in Japan on a manmade island” (Wikipedia, 2011g) The funding structure of the Chūbu Centrair International Airport is illustrated in Table 3-12 and Figure 3-14.

Table 3-12 The Chūbu Centrair International Airport Financing

Funding source	Amount (million USD)
Central government subsidy	410
Regional government subsidy	102
Private companies subsidy	512
Central government interest-free loan	1638
Regional government interest-free loan	410
Government-backed bond from Japan Development Bank	3225.6
Investment from the private sector	1382.4

Source: Sakamoto, Personal communication, Jan 17, 2011

Figure 3-14 Chūbu Centrair International Airport Financing



Source: Sakamoto, Personal communication, Jan 17, 2011

3.6.5. Difference between Financing HSR and Other Transportation Projects in Japan

In Japan, some HSR projects are profitable, such as the Tokaido-line the Sanyo-line, and the Tohoku and Joetu-lin. The owners of these profitable HSR projects, the JR companies, are able to gather money in the stock market. Considering the fact that these profitable HSR projects were built originally by the Japanese

government and later bought by the JR companies based on these projects' profitability, we can equally say that the construction of these HSR projects were partly financed by private capitals. The higher profitability of the projects, the higher portion of fund the private capitals would contribute. In addition, the JR companies are willing to contribute private capitals to build some new profitable HSR lines, such as the Takasaki-Karuizawa line. But these JR companies would prefer not to spend money in less profitable HSR lines, such as the Hokuriku-line and the Extensional Tohoku-line. In addition, private capitals are also interested in the building of some profitable conventional railway projects, such as the Tohoku-Juhkan Line.

In contrast, road projects are still primarily funded by the government funds and no private capitals have ever taken part in this field. Almost all old and regional airports were invested by the central government and regional governments. However, private capital is becoming more and more important after the building of the Kansai airport. Difference between financing HSR and other transportation projects is illustrated in Table 3-13.

Table 3-13 Difference in Financing----Japan

Japan	Procurement Method	% Of Private Capital	Principal Funding Source	Principal Funding Agency	IPO	Other Innovative Financing Method
HSR projects	Traditional procurement method	Medium	Tax revenue of the central government and regional governments, JR capital	Both central and regional governments & JR companies	Yes	NA
Other railway projects	Traditional procurement method	Medium or high	Government subsidy, government loan, and private capital	Both central and regional governments	No	NA
Road projects	Traditional procurement method	Low	Tax revenue of the central government and regional governments	Both central and regional governments	No	NA
Airport and seaport projects	Traditional procurement method	Medium	Government subsidy, government loan, and private capital	Both central and regional governments	No	NA
Urban transportation projects	NA	NA	NA	NA	NA	NA

Source: summarized by the author

3.7 Conclusion

Difference between HSR financing in different countries can be summarized in Table 3-14 and Table 3-15.

Table 3-14 Comparison of HSR System in Different Countries

	Scale	Existence of conventional railway system	Maximum speed	Isolated/connected	Motivation
China	7431 km	Yes	350km/h	Isolated from other countries, connected within the country	Capacity constraint, economic stimulus
Germany	1900km	Yes	300km/h	Connected with other countries, connected within the country	Economic stimulus, connect to EU railway network
Taiwan	345 km	Yes	300km/h	Isolated from other countries, connected within the country	Capacity constraint, environmentally friendly
Portugal	165 km	Yes	350km/h	Connected with other countries, connected within the country	Capacity constraint, economic stimulus, connect to EU railway network
Japan	2459 km	Yes	300km/h	Isolated from other countries, connected within the country	Capacity constraint, economic stimulus

Source: summarized by the author

Table 3-15 Comparison of HSR Financing in Different Countries

	Procurement Method	% Of Private Capital	Principal Funding Source	Principal Funding Agency	IPO	Other Innovative Financing Method
China	Traditional procurement method	Low	Bond Issued by MOR	The Central government & provincial governments	Never used	NA
Germany	Traditional procurement method	Low	The federal government fund, the federal states fund, EU funds, and capital of the DB Netz AG	The federal government, the federal state & the DB Netz AG	Never used	NA
Taiwan	PPP	Low	The government fund, IPO, private capital and local bank loan	Taiwan government & private companies	Yes, but with tax incentive	No
Portugal	PPP	Low	EU funds and EIB loan	The central government & private companies	No	No
Japan	Traditional procurement method	Medium or high	Tax revenue of the central government and regional governments, JR capital	Both central and regional governments & JR companies	Yes	NA

Source: summarized by the author

According to Table 3-5, Table 3-6, Table 3-8, Table 3-10, Table 3-13, Table 3-14 and Table 3-15, difference between financing HSR and other transportation projects in China, Germany, Taiwan, Portugal and Japan can be summarized below:

- The international evidences of the PPP application in HSR development are mixed: some countries use PPP as their HSR procurement methods, while others don't.
- The ability to attract private capital depends heavily on the project's profitability itself, and does not depend on which transportation modes the projects are. Generally speaking, compared to road, airport, and seaport projects, HSR projects are relatively harder to attract private capital and rely

more on the government's funding capabilities because the profitability of HSR projects is lower. This is not true in Japan, in which HSR projects are more profitable than road projects.

- Whether stock IPO is feasible for HSR projects also depends heavily on the project's profitability. Generally speaking, stock IPO is infeasible for HSR project financing because HSR projects are not profitable. This is also not true in Japan, in which some HSR projects are very profitable. On the other hand, stock IPO can be used to gather money for HSR projects when the government is willing to give tax incentives, just like the Taiwan case.
- Compared to bank loan, bond is less widely used in the building of all transportation modes, including HSR building. China uses bond financing more heavily than other countries do: China issues railway bonds to finance HSR and railway projects, issues state bonds to finance road projects, and issues project bonds to finance airport projects. This may indicate that bond financing is less appropriate for infrastructure financing, but may also indicate that more unexplored opportunities exist in bond capital markets.
- Compared to Germany, Portugal relies more heavily on EU funds and EIB loan to finance its transportation infrastructure projects, especially its HSR projects. This makes Portugal's infrastructure building more vulnerable to EU policy change.
- HSR systems connected with other countries are more likely to get financial support from multilateral agencies (e.g. the World Bank, the European Investment Bank, the Asian Development Bank, etc.) than HSR systems isolated from other countries do because the HSR systems connected with other countries may generate positive external effects internationally. For example, German and Portuguese HSR systems both get financial support from the European Union and the EIB because of their contribution to the TEN-T HSR network in Europe. At the same time, one reason that Taiwan, China, and Japan HSR systems don't get any financial support from multilateral agencies is probably that these HSR systems can not generate external benefits for other countries.

4. Innovative Methods of Financing HSR

4.1. Overview

In Chapter 2, *Crowding Out Effect Of HSR Investments*, we conclude that if we define the crowding out effect as the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investments of the society when HSR is being built, or the effect that investments in other transportation modes decrease as a percentage of the total fixed asset investments in transportation when HSR is being built, the crowding out effect of HSR investments on other transportation projects does exist worldwide.

In Chapter 3, *Difference between Financing HSR and Other Transportation Projects*, we conclude that compared to Germany, Portugal relies more heavily on EU funds and EIB loans to finance its HSR projects, and this reliance makes the HSR development in Portugal more vulnerable to the EU policy change. We need to explore more HSR funding opportunities for Portugal in the future. In addition, after the comparative studies of China, Germany, Taiwan, Japan and Portugal, we find that bank loans are more widely used to finance the HSR projects than bonds, but China relies a lot on its railway bonds (although implicitly backed by the Chinese government) to finance its HSR and other railway project investments. This may indicate that some unexplored opportunities exist in bond capital markets.

The purpose of this chapter is to compare different innovative financing methods and find the most financially cost-effective one for building Portuguese HSR projects. At the same time, the decrease of financial costs of HSR investments can also help counter the negative crowding out effect of HSR investments on other transportation modes, and help Portugal lower its dependence on EU funds and EIB loans in Portuguese HSR financing. It should be clearly pointed out that the word “innovative” here just mean that these financing methods are new or innovative for HSR investments, although they have already been used to finance other kinds of projects.

Financial costs of building Portuguese HSR may include interest payments to bond holders or banks; fees paid to debt insurance companies like monolines²¹; debt or stock issuance costs paid to investment banks, auditors, law firms and so on; and equity return required by stock holders (although this item will not be shown in the income statement of HSR projects). Generally speaking, equity investors of HSR projects are willing to provide HSR projects upfront capital funds only when they expect HSR projects can generate enough net income or cash flow for them in the operation phase. However, too many financial costs, which are typically incurred in the operating phase of HSR projects, can turn the net income of HSR projects negative in the operating phase, not to mention that HSR projects can generate enough net income for the HSR equity investors to cover their original capital investments. For example, in the case of Taiwan HSR, the total financial expenses account for more than 100%, 80% and 50% of the operating revenues in 2007, 2008, and 2009, respectively. The income statement of THSR is illustrated in Table 4-1. Comparison between operating revenue and total financial cost of THSR is illustrated in Figure 4-1 Operating Revenue VS. Total Financial Cost of THSR Figure 4-1, and the percentage of total financial cost in operating revenue is illustrated in Source: 1. Taiwan High-Speed Rail Company. 2007. 2007 Financial Report. Retrieved April. 2011 from http://www.thsrc.com.tw/download/tc/file/01/thsrc_f_96_full.pdf; 2. Taiwan High-Speed Rail Company. 2008. 2008 Financial Report. Retrieved April. 2011 from http://www.thsrc.com.tw/download/tc/file/01/thsrc_f_97_full.pdf; 3. Taiwan High-Speed Rail Company. 2009. 2009 Financial Report. Retrieved April. 2011 from http://www.thsrc.com.tw/download/tc/file/01/thsrc_f_98_full.pdf

Figure 4-2.

The Portuguese government should pay special attentions to the financial costs of HSR since these high financial costs will require the government to inject more money even after operation, or they will require the government to contribute more capital at the beginning no matter which procurement methods are used, PPP or the traditional government procurement methods.

²¹ Monoline companies are companies whose sole line of business is to provide bond insurance services to one industry are called monoline insurers. The term 'monoline' eventually became synonymous in some literature with terms like 'financial guarantors'. This definition is also in *List of Definition*. Source: Wikipedia (2011). Bond insurance. Retrieved Feb 14th from http://en.wikipedia.org/wiki/Monoline_insurance#Monoline_Insurance

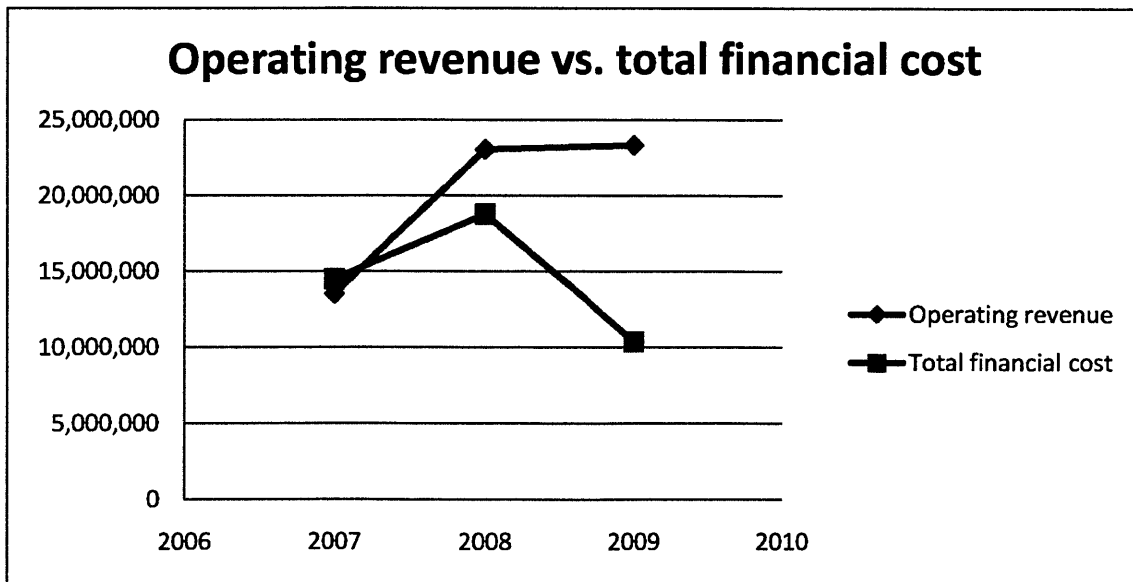
Table 4-1 Income Statement of Taiwan HSR

Item	2007	2008	2009
Operating revenue	13,502,788	23,047,583	23,323,712
Operating costs	-28,411,845	-29,286,136	-17,758,866
Operating income	-14,909,057	-6,238,553	5,564,846
Financial revenue	315,187	644,500	639,869
Interest	-14,423,091	-17,464,896	-10,778,335
Other financial expenses	-381,733	-1,950,748	-217,505
Total financial cost	-14,489,637	-18,771,144	-10,355,971
Net pre-tax income	-29,398,694	-25,009,697	-4,791,125
Tax/tax refund	-54	0	1,670
Net income	-29,398,748	-25,009,697	-4,789,455

Note: the unit used here is thousands of NTS

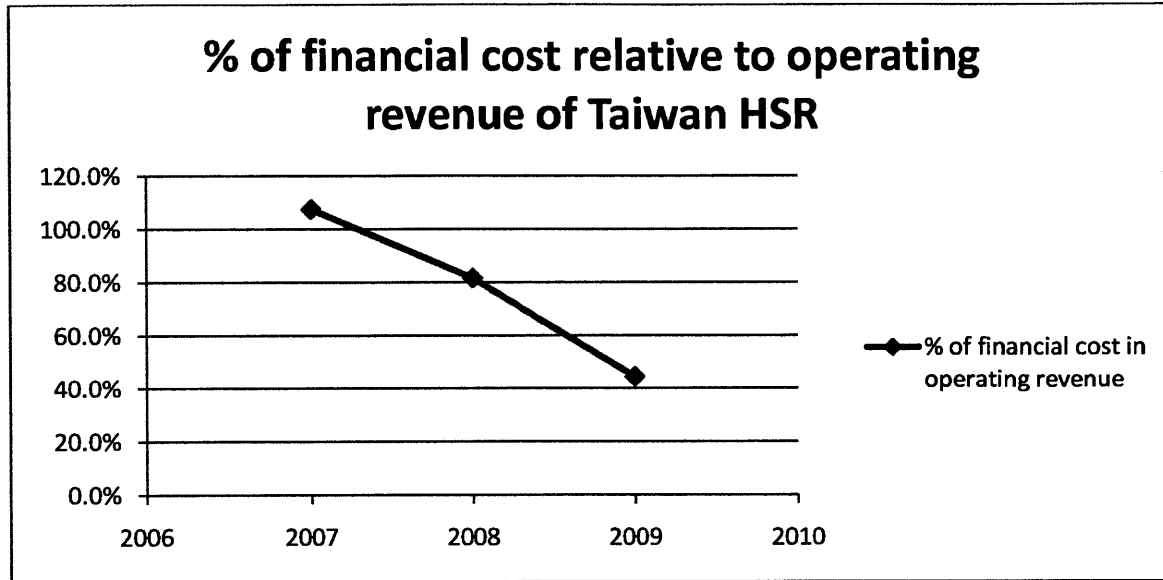
Source: 1. Taiwan High-Speed Rail Company. 2007. 2007 Financial Report. Retrieved April. 2011 from http://www.thsrc.com.tw/download/tc/file/01/thsrc_f_96_full.pdf; 2. Taiwan High-Speed Rail Company. 2008. 2008 Financial Report. Retrieved April. 2011 from http://www.thsrc.com.tw/download/tc/file/01/thsrc_f_97_full.pdf; 3. Taiwan High-Speed Rail Company. 2009. 2009 Financial Report. Retrieved April. 2011 from http://www.thsrc.com.tw/download/tc/file/01/thsrc_f_98_full.pdf

Figure 4-1 Operating Revenue VS. Total Financial Cost of THSR



Source: 1. Taiwan High-Speed Rail Company. 2007. 2007 Financial Report. Retrieved April. 2011 from http://www.thsrc.com.tw/download/tc/file/01/thsrc_f_96_full.pdf; 2. Taiwan High-Speed Rail Company. 2008. 2008 Financial Report. Retrieved April. 2011 from http://www.thsrc.com.tw/download/tc/file/01/thsrc_f_97_full.pdf; 3. Taiwan High-Speed Rail Company. 2009. 2009 Financial Report. Retrieved April. 2011 from http://www.thsrc.com.tw/download/tc/file/01/thsrc_f_98_full.pdf

Figure 4-2 % of Financial Cost Relative to Operating Revenue of Taiwan HSR

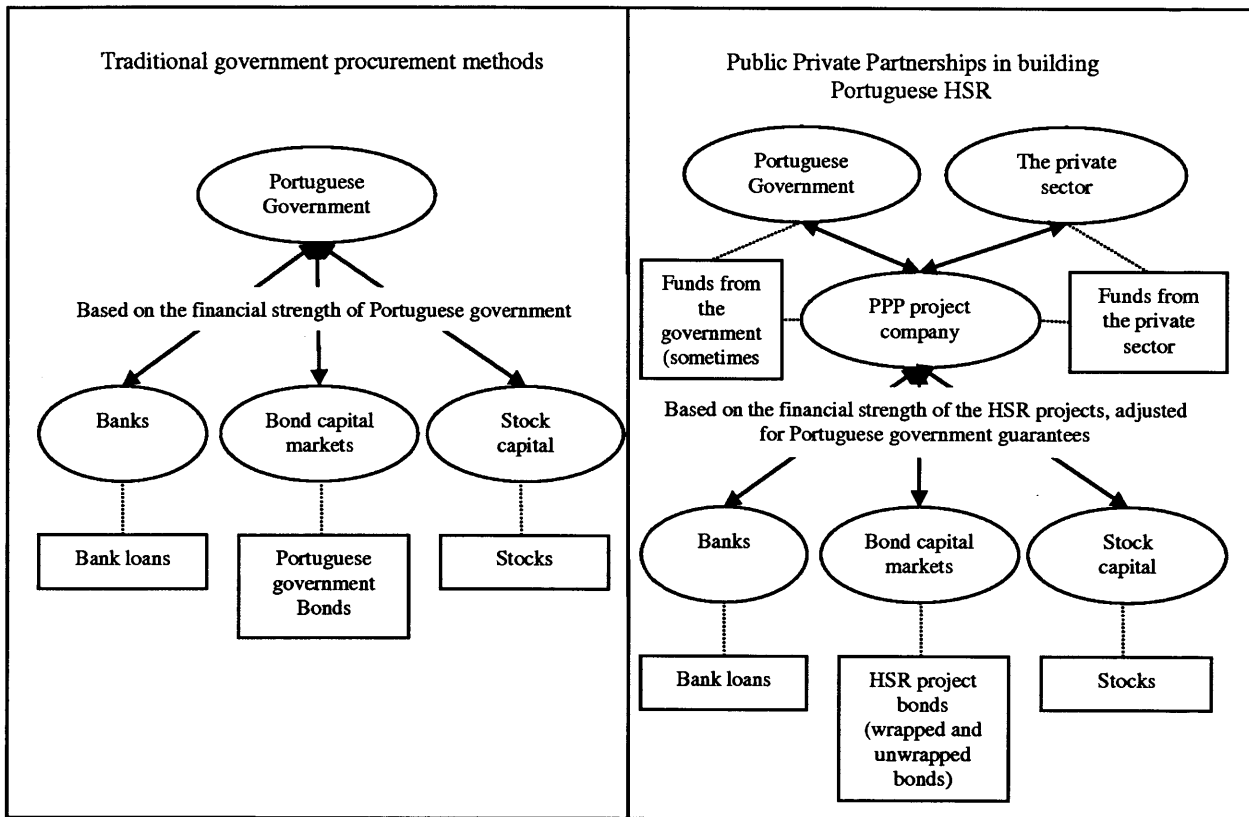


Source: 1. Taiwan High-Speed Rail Company. 2007. 2007 Financial Report. Retrieved April. 2011 from http://www.thsrc.com.tw/download/tc/file/01/thsrc_f_96_full.pdf; 2. Taiwan High-Speed Rail Company. 2008. 2008 Financial Report. Retrieved April. 2011 from http://www.thsrc.com.tw/download/tc/file/01/thsrc_f_97_full.pdf; 3. Taiwan High-Speed Rail Company. 2009. 2009 Financial Report. Retrieved April. 2011 from http://www.thsrc.com.tw/download/tc/file/01/thsrc_f_98_full.pdf

We believe Portugal is almost certain to use PPPs as procurement methods in building its HSR projects in the future. The planned HSR projects in Portugal are illustrated in Figure 1-1. There are three reasons: the European Commission would like to attract more private capital to build the Ten-T priority network (European Commission, 2005), and this desire may substantially influence Portugal’s choice of procurement methods since the EU Cohesion funds and Ten-T funds account for a large portion of the total fund of the Portuguese HSR investments. Secondly, the budget constraints of the Portuguese government in the foreseeable future makes PPPs more attractive in its HSR financing since PPPs can be used to delay payments for infrastructure building. Lastly, Portugal has gained the experience of using PPPs to finance its HSR projects, e.g. the Poceirao-Caia HSR project, and most of its road projects: this experience will definitely help Portugal in the future.

The difference between using traditional government procurement methods and PPP in building Portuguese HSR is illustrated in Figure 4-3:

Figure 4-3 Difference between Traditional Government Procurement Methods and PPP in Portuguese HSR Projects



Source: sketched by the author

Since the Portuguese government is almost certain to use PPP to build its HSR projects, this chapter will focus only on exploring innovative financing methods in this PPP case. As illustrated on the right side of Figure 4-3, the innovative financing methods discussed here are used by the private sector to get money from banks, bond markets, or stock markets to build the HSR projects. These methods are based on the financial strength of the HSR projects themselves, instead of the financial strength of the Portuguese government. The lower the financial costs the private sector can achieve when getting money from banks, bond markets, or stock markets, the lower the bids the private sector will offer in the bidding process of the Portuguese HSR PPP, which in return, benefits the Portuguese government. However, because HSR projects often don't have good financial strength and may have difficulties using these innovative methods, we need to identify additional revenues for HSR projects and increase their financial strength.

Actually, we will examine the relationship between megaregions and HSR, and identify megaregion revenues for HSR financing in Chapter 5, *Megaregions and HSR Financing*.

In this chapter, we will focus significantly on bank loans and project bonds, including both wrapped and unwrapped bonds²², because they are the most widely used ways to finance infrastructure projects in the world now. We will first examine the PPP project rating mechanism since it determines the financial cost of unwrapped bonds. Then we will compare wrapped bonds with unwrapped bonds, and compare wrapped bonds with bank loans, to see which financing method is most financially cost-effective and is most appropriate for building Portuguese HSR. We also take a close look at the wrapped bond financing after the current financial crisis since this financing method has been changed a lot since the financial crisis. In addition, we take a close look at the Portuguese pension fund market since pension funds and life insurance companies are the two most important project bond buyers in the world. At the end of this chapter, we will provide suggestions for the institutional structure to facilitate the use of the most financially cost-effective financing methods. And we will also briefly discuss other innovative financing opportunities includes stock IPOs, co-lending, etc.

4.2. Bond Financing for PPP Projects

4.2.1. Bond Financing History

The use of bond financing in PPP projects differs widely among the European countries. Bond financing has been most prevalent in the United Kingdom since the launch of the UK's Private Finance Initiative (PFI, one kind of PPPs) in the 1990s. In the UK, bond financing has been very popular in large PPP project financing (> £ 200 million in capital value) for the last decade. (European PPP Expertise Centre, 2010)

PPP project bond financing has been less popular in other countries for a variety of reasons: insufficient demand for PPP project bonds, due to the lack of enough private pension fund assets; illiquidity of PPP project bonds, due to the lack of a deep capital market; severe competition from bank loan financing, which is considered an alternative for bond financing all the time—the details of this will be discussed

²² The PPP project bonds fully insured by monolines are called wrapped bonds. The PPP project bonds not insured by monolines are called unwrapped bonds.

later in the section *Bank Loan & Bond Market for PPP Projects*; and both the public and the private sector have insufficient knowledge of PPP project bond financing. (European PPP Expertise Centre, 2010)

Portugal didn't use bonds to finance its Poceirao-Caia HSR project. As illustrated in Chapter 3, *Difference between Financing HSR and Other Transportation Projects*, the funds for the Poceirao-Caia HSR project come mostly from EU cohesion grants, EU TEN-T grants, and EIB loans, with a small portion of funds come from Portugal commercial banks and no funds come from bond issuance. The map of the Poceirao-Caia HSR project is illustrated in Figure 3-10. The funding structure of the Poceirao-Caia HSR project is illustrated again in Figure 3-11.

4.2.2. Key Bond Buyers and Bond Rating

Key bond buyers in PPP project bond market are usually institutions with long-term liabilities, against which they needed to have assets producing matching long term cash flows. More specifically, these institutions may include pension funds, life insurance companies, alternative investment funds, sovereign wealth funds, etc. Within these four, pension funds and life insurance companies are the two most important ones. (European PPP Expertise Centre, 2010) Therefore, when considering using bonds to finance Portuguese HSR projects, we should take a close look at the development of the Portuguese pension fund market, and we will do this in the later section of this chapter *Development of the Portuguese Pension Fund Market*.

Bond buyers are concerned mostly about the PPP project bond rating: pension funds and life insurance companies are generally only interested in bonds with investment grades or grades larger than Baa3²³. (European PPP Expertise Centre, 2010)

Without any outside financial support, e.g. monoline guarantees, PPP project bond rating is the same as PPP project rating. PPP projects are rated differently in both construction and operating phases, considering the difference between construction risks and operating risks. According to Moody's experience, PPP projects in the construction phase are usually rated Baa, while availability-payment PPP projects in the steady state of the operation phase are typically rated A. (Moody, 2010) This PPP project rating mechanism will be discussed in more detail later in the section of this chapter *PPP Project Rating*.

²³ The Moody's rating definition can be found in <http://en.wikipedia.org/wiki/Moody%27s>

4.2.3. Monolines and Wrapped Bonds

Compared to infrastructure projects using the traditional procurement methods, PPP projects are more complex: according to European PPP Expertise Centre (2010), “PPP projects usually have a long lead time before financial close during which the commercial terms and the financing terms are negotiated.” Unlike banks, the institutional buyers for PPP project bonds don’t have inside capability to analyze the risks associated with PPP projects in the history, and they generally don’t have enough time or knowledge to effectively monitor their investments closely, which make PPP project bonds less attractive to these institutional buyers.

The emergence of high-rating monolines (mostly Aaa), one kind of private insurance, closes this gap: monolines provide insurance for the bonds in exchange for a certain insurance fees; on the other hand, monoline companies will analyze the risks associated with PPP projects and monitor the project development on behalf of bond investors. The PPP project bonds fully insured by monolines are called wrapped bonds. The PPP project bonds not insured by monolines are called unwrapped bonds. Moody usually rates the wrapped bond using the higher of underlying project rating and the relevant monoline company rating. It is worth noticing that in the UK, only two early projects were funded with unwrapped bonds after the first PPP project was financed through the capital markets. (European PPP Expertise Centre, 2010)

The logic behind this monoline wrapped bond model is that the financial cost of bond issues is much lower if bonds are issued using monolines’ rating, instead of their own low Baa rating in the construction phase. Even after paying insurance fees to monolines, bond issuers can still save significant amount of money. However, the key for the success of this model is the ability of monolines to maintain a high rating, such as Aaa. If the ratings of monolines fall to a certain grade, this model will not work anymore. (European PPP Expertise Centre, 2010)

Unfortunately, after the 2008 financial crisis, most monolines’ ratings have fallen significantly. For example, the rating of monoline Syncora Guarantee Ltd. fell from Aaa in June 2007 to Ca in November 2009 using Moody’s rating²⁴. The rating decay of these monolines significantly infects the effectiveness

²⁴ Moody’s rating is listed in the *List of Definition*.

of this wrapped bond model. (European PPP Expertise Centre, 2010) We will discuss these wrapped and unwrapped bonds in more detail later.

4.3. PPP Project Rating

Currently, Moody considers PPP projects in the construction phase and in the operation phase separately. (Moody, 2006) PPP projects in construction are typically rated by Moody in the Baa category, whereas availability payment ²⁵PPP projects in steady state operations are typically rated in the A category. (Moody, 2010) As a result, if a project can complete its construction on time, we will generally see an upgrading of the project rating.

4.3.1. Rating of PPP Projects in the Construction Phase

In a typical PPP transaction, there is usually a concession agreement (CA) between project companies and off-takers. Here the project company refers to a new company formed by the private sector to be only responsible for fulfilling the requirements in the concession agreement. The asset of the project company is usually the asset the company needs to develop, for example, roads and HSR. And the project company usually borrows money from the bond market or from banks based on the profitability of the asset, or the potential asset.

Here the off-taker refers to the entity that promises to pay money to the project company based on certain criteria, which are usually related to the quality and quantity of service or goods the project company provides. This off-taker is usually the government in availability payment projects or shadow toll projects. For example, the Portuguese government is the off-taker in the Poceirao-Caia High-Speed Rail project: the Portuguese government will pay the project company based on availability (75%), maintenance (25%) and demand (+-2%). There are no off-takers in real toll road projects since drivers don't promise to buy anything in advance.

In the construction phase, there is usually a design-build agreement (DBA) between project companies and construction companies. The DBA typically requires construction companies to be responsible for those costs associated with construction cost overrun and construction schedule delay. (Moody, 2006)

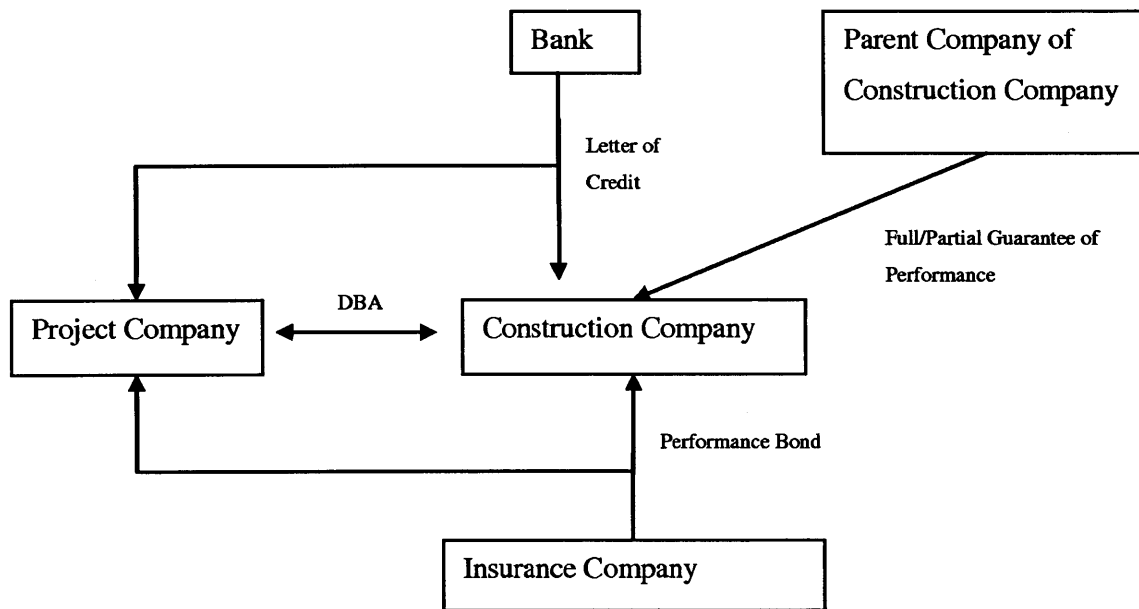
²⁵ The definition of availability payment is in *List of Definition*.

PPP project bond investors are rarely willing to accept the raw construction risks, such as construction cost overrun and construction schedule delay. Therefore in the design-build agreement, PPP project companies usually either require the construction companies to provide a construction risk mitigation package or assume some of the costs directly. PPP project companies may also require the parent companies of construction companies to provide performance support.

In addition to that, project companies may also seek outside financial support, such as letter of credit from banks, and performance support, such as performance bond from insurance companies to protect themselves from cost and time overrun.

The typical PPP design-build structure can be summarized in Figure 4-4:

Figure 4-4 Typical PPP Design-Build Structure



Source: Moody (2006), Construction Risk in Privately-Financed Public Infrastructure (PFI / PPP / P3) Projects.

Finally, projects are rated by Moody considering raw construction risks, support from construction companies in design-build agreements, performance support, financial support, and equity. (Moody, 2006)

The details of this rating method are summarized as follows:

- Raw construction risk: raw construction risk is the expected loss on project itself without any outside support. The expected loss can be calculated as the product of probability of the project

schedule delay or cost overrun and amount of costs associated with them. According to Moody's experience, the project's complexity is the most important factor that determines the raw construction risk. Moody divides most PPP projects into four types: Standard Buildings, Standard Civil Infrastructure, Complex Buildings and Complex Civil Infrastructure, and assigns the base rating based on the type. (Moody, 2006)

- Support from construction companies in the design-build agreements: there may be clauses in the design-build agreements requiring construction companies to be responsible for completing projects on time, absorbing the costs of schedule delay and cost overruns, etc. When calculating the value of this support in DBA, Moody considers the ability and willingness of construction companies to do so. (Moody, 2006)
- Performance support: performance support, usually issued by third-party insurance companies, is designed to protect project companies against the failure of construction companies or one of its sub-contractors in fulfilling their construction obligations. Types of performance support include performance bonds, completion insurances, adjudication bonds, sub-contractor insurances, and so on. However, the credit enhance value of performance support is not as much as its nominal value because it is rarely provided on time and in full amount of the claim. (Moody, 2006)
- Financial Support: financial support, similar to performance support, typically issued by banks, is also designed to protect project companies against the failure of construction companies or one of its sub-contractors in fulfilling their construction obligations. The difference is that financial support is typically provided on time and in full nominal amount. The rating of banks providing this financial support is an extremely important factor when evaluating the effect of this financial support. Common examples of financial support include bank letters of credit, bank guarantees and demand deposits at regulated financial institutions. (Moody, 2006)
- Equity: because equity investors can only claim the remaining profits after paying interests, and equity investors are in the first-loss positions, equity in nature provides credit support for the project debt. The higher percentage of equity to debt, the stronger credit support equity can provide. (Moody, 2006)

Therefore, important components of Moody's rating model of PPP projects in the construction phase can be summarized in Table 4-2:

Table 4-2 Important Components of Moody's Rating Model of PPP Projects in the Construction Phase

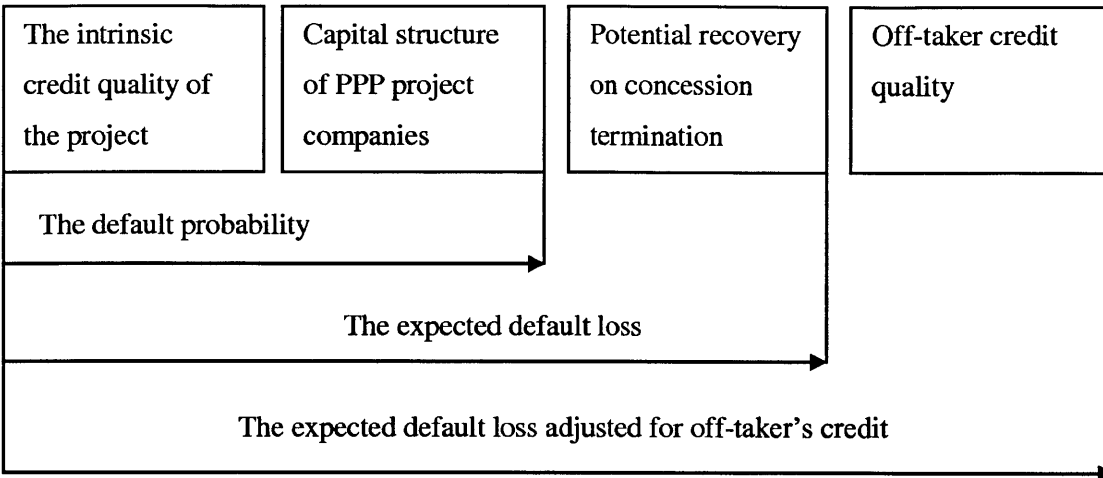
Components of Moody's rating model	Key considerations of these components
Raw construction risks	Probability of the project going over time/over budget, amount of budget overage/cost of schedule overage, and the project's complexity
Support from construction companies in design-build agreements	Related clauses in design-build agreements, construction companies' willingness and abilities to provide this support
Performance support	How fast the support can be provided on time and what percentage of full claimed amount can be provided
Financial support	Bank rating
Equity	The ratio of equity to debt

Source: Moody (2006), Construction Risk in Privately-Financed Public Infrastructure (PFI / PPP / P3) Projects.

4.3.2. Rating of PPP Projects in the Operation Phase (Availability Payments)

For availability-payment PPP projects, Moody's rating is based on four considerations: the intrinsic credit quality of the project, capital structure of PPP project companies, potential recovery on concession termination, and off-taker's credit quality. Actually, the intrinsic credit quality of the project and the capital structure of PPP project companies together determine the default probability; these two and the potential recovery on concession termination together determine the expected loss of default; all of these four factors together determine the expected default loss adjusted for off-taker's credit quality. (Moody, 2007) These four considerations are illustrated in Figure 4-5.

Figure 4-5 Factors Used by Moody for PPP Project's Rating in the Operation Phase



Source: Moody (2007). Request for Comment on: Operating Risk in Privately-Financed Public Infrastructure (PFI/PPP/P3) Projects.

These can be illustrated as follows:

- The intrinsic credit quality of the project: the intrinsic credit quality is the most important factor Moody considers. It can be determined by the volatility of the PPP project's revenue, costs of service delivery, and force majeure²⁶ risk. (Moody, 2007)
 - The volatility of the PPP project's revenue is determined by the project's complexity, the standards that the government uses to measure the performance of PPP projects, and the inflation exposure. Usually, the revenue volatility increases when dealing with more complex projects, such as High-Speed Rails; the revenue volatility increases when off-takers or governments set higher performance measurement standards, which increase both the probability and costs of revenue deduction. The higher degree that operation costs exposed to inflation, the higher revenue volatility is. (Moody, 2007)
 - Costs of service delivery: here Moody considers two factors, the predictability and stability of operation costs, and the depth of the market. The cost risks decrease as the predictability of operation costs become better and as more reputable suppliers are in the market. (Moody, 2007)

²⁶ The definition of force majeure is listed in *List of Definition*.

- Force majeure risk: force majeure risk refers to the probability and costs of the project agreement being terminated due to force majeure. In most cases, PPP project bond issuers or PPP project companies can relieve their responsibilities for providing the service when the force majeure happens. The key point here is whether project companies can still get paid by off-takers, how much they get paid and what percentage of the Issuers' operating costs can these payment covers. (Moody, 2007)
- Capital structure of PPP project companies: Moody also considers the safety margin effect of the project company's capital structure. As the percentage of debt increases, the safety margin decreases and the probability of default grows. This safety margin effect is measured by Moody using three ratios: a minimum debt service coverage ratio (DSCR), an average DSCR on a post-tax basis, and a cash break-even ratio. DSCR is defined as the ratio of net cash flow available divided by senior debt service. The minimum and average DSCR test the project company's exposure to debt service costs and measures its ability to sustain lower cash flow from unexpected events before debt service is default. A cash break-even ratio is defined as the maximum percentage that projected operating and capital expenses can be increased when the net cash flow is still enough to cover service debt and meet all other costs when due. This cash break-even ratio tests the project company's exposure to the increase of operating costs. (Moody, 2007)
- Recovery on concession termination: this reflects Moody's view of the likely bond principal recovery if the transaction is terminated early. Concession termination regime and recovery assumptions are the two most important considerations here. (Moody, 2007)
- Off-taker's credit quality: Moody also adjusts its rating for off-taker's credit quality since this credit quality determines whether project company can get paid timely and in full amount, and whether it can get a termination payment when the project is terminated. (Moody, 2007) Moody's typically maintains at least a two-notch difference between the credit quality of off-takers and the rating of PPP projects. (Moody, 2010). Based on the current Moody's rating A1 for the Portuguese government, all PPP projects in Portugal, including the Portuguese HSR projects, at most get A3 rating if the Portuguese government is the project off-taker and no other measures are taken.

Important components of Moody's rating model of PPP projects in the operation phase are summarized in Table 4-3

Table 4-3 Important Components of Moody's Rating Model of PPP Projects in the Operation Phase

Components of Moody's rating model	Key considerations of these components
The intrinsic credit quality of the project	The volatility of the PPP project company's revenue, its costs of service delivery, and force majeure risk
Capital structure of PPP project companies	A minimum debt service coverage ratio (DSCR), an average DSCR on a post-tax basis, and a cash break-even ratio
Recovery on concession termination	Concession termination regime and recovery assumptions
Off-taker's credit quality	The credit quality of the off-taker is at least two notches higher than the rating of the PPP project

Source: Moody (2007). Request for Comment on: Operating Risk in Privately-Financed Public Infrastructure (PFI/PPP/P3) Projects.

4.3.3. Rating of PPP Projects in the Operation Phase (with Exposure to Commercial Revenue Risk)

Generally speaking, projects exposed to commercial revenue risk get much lower rating than projects with predictable availability payments²⁷. Most projects with commercial revenue risk are rated Baa2 or Baa3, while most projects with predictable availability payments are rated Baa1 or even A1 in the operating phase. (Moody, 2008b)

When analyzing projects exposed to commercial revenue risk (maybe full risk or maybe only partial risk), Moody (2008b) "asks the following fundamental questions: Who bears the commercial revenue risk and to what extent? What is the quality and predictability of the commercial revenues? What level of cushion is incorporated in the proposed credit metrics in order to deal with market revenue risk?"

One thing that Moody pays special attentions here is the minimum revenue, the portion of the revenues which is going to be available in the worst scenarios. Moody calculates the minimum and average debt service coverage ratio (DSCR), and the cash break-even ratio based on this minimum revenue estimate,

²⁷ The definition of availability payment is in *List of Definition*.

and compares the results with certain thresholds: 1.05x for minimum DSCR, 1.10x for average DSCR, and 15% for cash break-even ratio. (Moody, 2008b)

Only when the calculated ratios are larger than the threshold ratios, Moody uses the rating methods of availability payment projects to evaluate these projects with exposure to commercial revenue risks. If the calculated ratios fall squarely below the threshold Ratios, these projects are supposed to be greatly exposed to commercial revenue risks and the evaluation result from the rating methods of availability payment projects can only be used to determine an upper bound. (Moody, 2008b)

Therefore, we can conclude that here the most important factor Moody considers when rating these projects with commercial revenue risks is the minimum revenue, not the average revenue or the maximum revenue. It would be good if we can ensure predicable minimum revenue using insurances or derivatives, such as real options and futures.

4.3.4. Influence of Public Capital Contribution in PPP Project Rating

Here the public capital contribution means the capital provided by public sectors in the construction phase for supporting the PPP project building. It is very interesting that Moody concludes that public capital contributions generally have an adverse impact on senior debt credit quality in most new PPP projects. (Moody, 2009)

For traditional government procurement projects, the public capital contribution is good for debt rating since it may turn the original negative NPV into positive NPV by adding an initial cash inflow, and make the project internal cash flows strong enough to be financially viable. In Moody's view, this public capital contribution here is like "a free lunch" to the projects. This usually happens to the projects with very positive social-economic value to the communities but without sufficient internal revenues to cover their costs. (Moody, 2009)

Moody argues that the public capital contributions for PPP projects are different from those for the traditional government procurement projects because these public capital contributions are just the current value of future payments from the government to the PPP project companies, instead of "a free lunch" to the PPP project companies. The logic is that, if the government doesn't pay the initial capital contributions, it has to pay higher availability payments later in the operation phase for both projects with

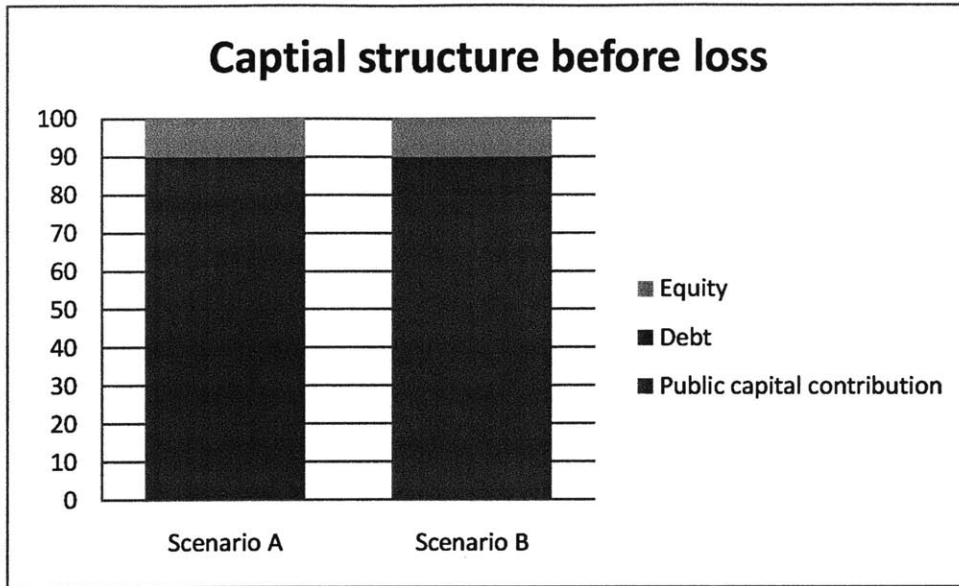
availability payments and with partial revenue risks. Otherwise, no private companies will be willing to take part in these kinds of PPP projects. (Moody, 2009)

Moody also argues that the public capital contributions are worse than the future availability payments with the same estimated NPV values because these public capital contributions are usually paid progressively during project construction. The payment of capital contributions are typically based on the degree of project completion. Only when the degree of project completion reaches a certain point, the project companies can get paid. Therefore, the private capital, including the capital gathered from bond issuance proceeds, bears all project completion risks. In this case, the public capital contributions are like the most senior debts to the projects and are in the last loss position. (Moody, 2008c) On the other hand, if the government doesn't provide these capital contributions, the private project companies have to provide these additional funds in advance in the form of equity, junior debt, or at most senior debts like the issued bonds. In this case, the bond is still in the last loss position. (Moody 2009) A more detailed example is provided below:

Example: in this example, the total funding needs are 100 million USD. In scenario A, this 100 million USD is funded by 90 million USD debts and 10 million USD equity. In scenario B, this 100 million is funded by 80 million public capital contributions, 10 million USD debts and 10 million USD equity. This is illustrated in Figure 4-6.

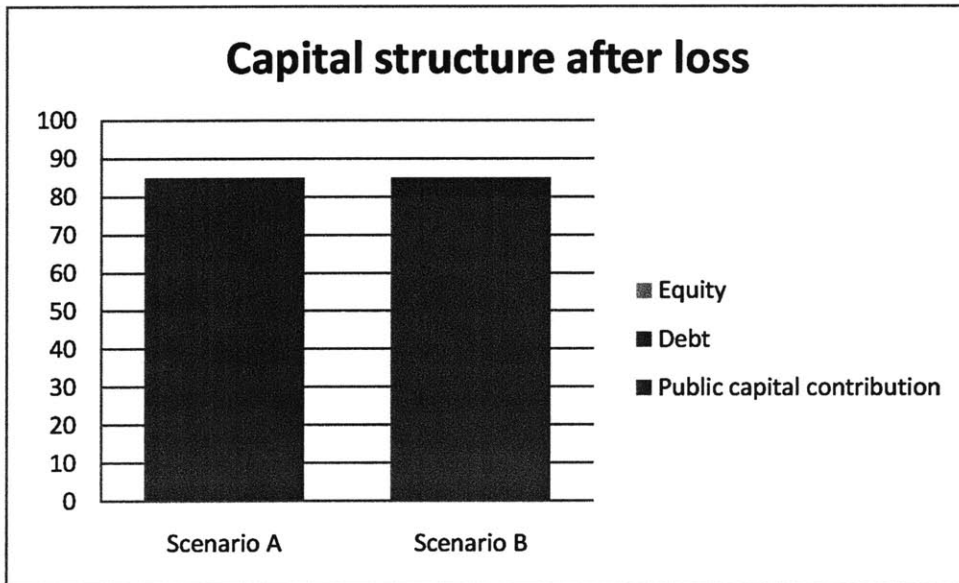
Considering a 15 million USD loss incurred in the projects, in both scenario A and B, this 15 million USD loss wipes out 10 million USD equity and another 5 million USD debt. However, since the total debt is 80 million USD in scenario A and only 10 million USD in scenario B, the debt recovery rate is $85/90=94\%$ in scenario and $5/10= 50\%$ in scenario B. This is illustrated in Figure 4-7.

Figure 4-6 Example Used to Illustrate the Influence of Public Capital Contributions



Source: summarized by the author

Figure 4-7 Example Used to Illustrate the Influence of Public Capital Contributions



Source: summarized by the author

The debt recovery rate is much higher in scenario A (without public capital contributions) than that in scenario B (with public capital contributions), and therefore this example illustrates the negative effect of public capital contributions on PPP project rating.

4.3.5. Conclusion of PPP Project Rating

In the construction phase, although project companies cannot change the raw construction risk which is determined mainly by PPP project complexity, they can enhance the PPP project rating by cooperating with construction companies with good reputation, and adding clauses in the design-build agreements to require construction companies to absorb the costs of both budget and time over-runs. Project companies should also, try to find outside performance and financial support.

In the operation phase of availability-payment PPP projects, project companies can enhance their rating by making their operation cash flow more stable and getting higher termination payments: they can benefit from using future or real options to hedge their operation material risks, and getting a more advantageous project termination regime toward them. In the operation phase of projects with partial revenue risks, project companies should pay special attentions to the worst-case revenue, which is the key consideration of Moody's rating. Project companies can benefit from using insurances, or financial derivatives to make sure they get enough minimum revenue, even though this may sacrifice some of the upward potentials of their revenue.

Generally speaking, governments will benefit from project companies' higher rating and lower financial costs because these can result in lower tender price in the PPP tendering. In some cases, the lower tendering price is the net benefit government can get without any costs. For example, governments can benefit itself by encouraging private project companies to pick up prestigious construction companies, seek outside performance and financial support, hedge their operation risks using derivatives, etc. In other cases, governments have to consider the trade-off between getting a low tendering price and keeping other benefits. For example, governments may get a lower tendering price by giving project companies more advantageous concession termination regime toward them, where governments lose certain benefits in the concession termination regime.

At the same time, it is interesting that the public capital contributions at the beginning are considering negative in Moody's rating if these capital contributions are paid progressively and based on the degree of project completion. To avoid this negative effect on rating, governments can use co-lending instead. We will discuss this co-lending in more detail later.

Lastly, we should notice that Moody typically maintains at least a two-notch rating difference between the credit quality of the off-taker and the rating of the PPP project. (Moody, 2010) Based on the current

Moody's rating ²⁸Baa1 for the Portuguese government, all PPP projects in Portugal, including the Portuguese HSR projects, at most get Baa3 rating if the Portuguese government is the project off-taker and no other measures are taken.

4.4. Wrapped Bond and Unwrapped Bond

According to European PPP Expertise Centre, there is a general consensus that bond capital markets are the best sources for PPP project financing. (European PPP Expertise Centre, 2010) Bond financing has been most prevalent in the United Kingdom since the launch of the UK's Private Finance Initiative (PFI, one kind of PPPs) in the 1990s. In the UK, bond financing has been very popular in large PPP project financing (> £ 200 million in capital value) for the last decade. (European PPP Expertise Centre, 2010)

Generally speaking, bonds can be divided into unwrapped and wrapped bonds. Wrapped bonds are the bonds fully insured by monolines, and unwrapped bonds are the bonds not insured by monolines. Moody usually rates unwrapped bonds using the underlying PPP project rating, and rates wrapped bonds using the higher of the underlying PPP project rating and the relevant monoline rating. (Moody, 2010)

The dominant use of the wrapped bond in the UK can be illustrated by the fact that only two projects funded by bonds were funded using unwrapped bonds since the first PPP project was financed in the capital markets in 1997. (European PPP Expertise Centre, 2010)

4.4.1. History of Monoline Wrapped Bonds

According to the European PPP Expertise Centre, monolines and wrapped bonds started in the early 1970s in the United States in response to a series of high profile municipal bond defaults. Historically, "the monolines' business model is to issue unconditional and irrevocable guarantees of timely payment of principal and interest to investors while maintaining a sufficient capital base against those guarantees to achieve Aaa ratings" (European PPP Expertise Centre, 2010) .

The rationale for this model is that the financial costs of bond issuers will be much lower if bonds are issued using monolines' rating, instead of their own low Baa rating in the construction phase. Even after

²⁸ Moody's rating is listed in the *List of Definition*.

paying insurance fees to monolines, bond issuers can still save a significant amount of money. On the other hand, monolines can earn fees from bond issuers to sustain their business.

However, the key factor for the success of this model is the ability of monolines to maintain a high rating, such as Aaa. If the ratings of monolines fall to a certain grade, this model will not work out anymore. (European PPP Expertise Centre, 2010)

4.4.2. Wrapped Bonds and Unwrapped Bonds

Compared to unwrapped bonds, wrapped bonds guaranteed by Aaa monoline companies can achieve much lower total financial costs, overcome the rating hurdle of institutional PPP project bond investors, close the rating gap between PPP project ratings in the construction phase and operation phase, provide effective project control after financial close, and ease the worry of PPP project bond investors on the transparency of PPP projects. The details can be summarized below:

- Achieve much lower total financial costs: compared to unwrapped bonds issued using the underlying project rating, wrapped bonds can achieve much lower coupon rate because their ratings are based on the higher of the underlying project rating and the monolines' rating. When the monolines' rating is very high, for example, Aaa, the interest rate gap between these two kinds of bonds will be huge. Even after paying a certain amount of fees to the monolines, PPP project companies, or PPP project bond issuers can still achieve a significant amount of financial cost saving. (European PPP Expertise Centre, 2010)
- Overcome the rating hurdle of institutional PPP project bond investors: typically, unlike banks, institutional PPP project bond investors, including pension funds and insurance companies, don't have the inside analytical capability and time to analyze each PPP projects they invest, and they rely on the project's rating to judge whether the investment is appropriate. These institutional bond investors avoid investing in projects with speculative rating, while most PPP projects cannot achieve high enough rating to attract these institutional bond investors without monolines' guarantees. The existence of monolines' guarantees provides a bridge linking these PPP project issuers and potential institutional PPP project bond investors since wrapped bonds are rated using the higher of the underlying projects and monoline companies, and these monoline companies are usually rated Aaa before the financial crisis. (Moody, 2010)
- Close the rating gap between PPP project ratings in the construction phase and operation phase: as stated in the *PPP project rating*, PPP projects in construction are typically rated in the Baa

category, whereas availability based PPP projects in the steady state of operation phases are typically rated in the A category. Without monoline guarantees, PPP project bonds have to be issued based on their construction phase ratings because these bonds are issued using the rating of the underlying projects. The existence of monoline guarantees close the rating gap between PPP project ratings in the construction phase and operation phase.

- Provide effective project control after financial close: generally speaking, PPP project creditors or PPP project bond investors need to monitor and make decisions regarding the activities of the PPP project companies. However, the principal PPP project bond investors, such as pension funds and insurance companies here, don't have enough analytical capability and time to monitor every project they invest in. The monoline business model solve these problems effectively: the monoline companies provide the necessary project monitoring on behalf of PPP project bond investors.
- Ease the worry of PPP project bond investors on the transparency of PPP projects: generally, it is always time consuming, and sometimes impossible for bond investors to gain enough detailed information of the PPP projects. These bond investors worry significantly about the credit information provided by PPP project bond issuers and find it very difficult to do related bond valuations. Therefore, without monoline guarantees, these bond investors will avoid investing in PPP project bonds, resulting in the value driven down for PPP project bonds. The monoline business model can ease the worry of PPP project bond investors on the transparency of PPP projects because in this model PPP project bond investors just need to know the detailed information of the monoline companies, which is much easier to access.

4.5. Bank Loan & Bond Market for PPP Projects

Bank loans and wrapped bonds seem to be the two most important kinds of financing instruments for infrastructure projects, including HSR projects, in the past. It is helpful to take a close look at the pros and cons of both bank loans and wrapped bonds.

Before the financial crisis, compared to bank loans, the advantages of wrapped bonds includes lower total financial costs, longer financing term, lower refinancing risks, and less lender-borrower negotiation costs:

- Lower total financial costs: Historically, monoline wrapped bonds have proved to be highly price competitive with bank debt. The total costs of bond financing were often much lower than that of bank financing before the financial crisis. (Moody, 2010) There are several reasons:

- Before the financial crisis, the monolines generally held Aaa ratings, which typically resulted in lower financial costs for wrapped bonds compared to bank loan financing;
 - Bonds are usually issued on fixed coupon rates. Bank loans are usually on floating rates and banks generally need to use swaps for risk hedging. This risk hedging increases the cost of bank loans and therefore make bank loans more expensive in PPP project financing;
 - Most bond investors, such as pension funds, have long-term liabilities that need to be matched with long-term assets while banks typically have short-term liabilities and long-term assets. Therefore, banks may require more liquidity premium in bank loans than that required by bond investors.
- Longer financing term: investors for bonds, such as pension funds and insurance companies, have naturally long-term liabilities which need to be hedged by long-term assets, or long-term investments. At the same time, banks, normally having relatively short-term liabilities, are more willing to lend shorter. (Moody, 2010)
 - Lower refinancing risks²⁹: since banks are generally not willing to lend for the full term of the project agreement or concession, a refinancing risk exists in bank loan financing. This refinancing risk is lower in bond financing since bond investors are generally willing to lend longer. (Moody, 2010)
 - Less lender-borrower negotiation costs: generally speaking, contractual agreements in PPPs, used by lenders to control the behaviors of borrowers, are the results of negotiations between lenders and concessionaries or borrowers at the beginning. Bank loan financing is usually in the form of syndicated loans, providing by a group of banks. In this case, concessionaries have to negotiate with a group of banks. However, in the case of wrapped bonds, concessionaries generally only have to negotiate with one monoline company, since this monoline company takes the first loss position of project default and bondholders have historically ceded control of the project. (Moody, 2010)

²⁹ In banking and finance, refinancing risk is the possibility that a borrower cannot refinance by borrowing to repay existing debt. Source: http://en.wikipedia.org/wiki/Refinancing_risk

Before the 2008 financial crisis, compared to bank loans, the disadvantages of wrapped bonds include the cost of negative carry³⁰:

- Negative carry: typically, in bond financing, borrowers receive bond issue proceeds at the start of the project’s construction phase, but construction fund needs are distributed across the whole construction phase. Therefore, bond proceeds are usually deposited in a Guaranteed Investment Contract (GIC) and funds are drawn when needed. The reality is that the interest earned from GIC are generally lower than bond interest payments, resulting in the negative carry of bond financing. In the bank loan financing, funds are drawn from banks when needed in the construction phase, so there is no negative carry in bank loan financing. Although commitment fees are charged on undrawn balances in bank loan financing, the cost of negative carry in bond financing is generally larger than the cost of commitment fees in bank loan financing.

Bank loans and wrapped bonds have almost the same deliverability risks:

- Traditionally, bond executions are considered to have a higher risk that funds may not be available, or available at uncompetitive prices. However, in large PPP projects, e.g. HSR projects, bank loan financing is usually in the form of syndicated loans. The syndication is a process requiring a significant amount of arrangement work. On balance, syndicated bank loan and bond financings are in similar levels of deliverability risks.

The pros and cons of both bank loans and wrapped bonds can be summarized in Table 4-4:

Table 4-4 Pros and cons of Both Bank Loans and Wrapped Bonds Can be Summarized As follows

	Bank loan	Wrapped bond
Total financial costs	higher	lower
Financing term	shorter	longer
Refinancing risk	higher	lower
Lender-borrower negotiation cost	higher	lower
Cost of negative carry or commitment fees	lower	higher
Deliverability risk	almost the same	almost the same

Source: European PPP Expertise Centre (2010). Capital markets in PPP financing.

³⁰ The carry of an asset is the return obtained from holding it (if positive), or the cost of holding it (if negative). This definition is also in *List of Definition*. Source: http://en.wikipedia.org/wiki/Carry_%28investment%29

4.6. Wrapped Bonds after the Financial Crisis

From the analysis in the section *Wrapped Bonds and Unwrapped Bonds*, we can see before the 2008 financial crisis, wrapped bonds had absolute advantages compared to unwrapped bonds, including achieving much lower financial cost, overcoming rating hurdle of institutional PPP project bond investors, closing the rating gap between PPP project ratings in the construction phase and operation phase, and so on.

From the analysis in the section *Bank Loan & Bond Market for PPP Projects*, we can see before the financial crisis, wrapped bonds had lower total financial costs, longer financing term, lower refinancing cost, and less lender-borrower negotiation cost compared to bank loan financing.

Therefore, wrapped bonds were very good financial instruments in PPP project financing before the current financial crisis. However, during the financial crisis, due to their exposure on asset-backed securities for which the underlying assets were sub-prime or other non-standard U.S. mortgage loans, the rating of monoline companies decreased a lot and the effectiveness of this monoline insurance wrapped bond model was severely impaired. (European PPP Expertise Centre, 2010) The rating change of some monoline companies can be illustrated in Table 4-5:

Table 4-5 Rating Change of Monoline Companies during the Financial Crisis

Monoline companies	June 2007	November 2009
Assured Guaranty Corp.	Aaa	Aa3
Assurance (UK) Ltd.	Aaa	Aa3
Ambac Assurance Corp.	Aaa	CC
MBIA UK Insurance Ltd.	Aaa	BB+
Syncora Guarantee (UK) Ltd.	Aaa	Ca
FGIC UK Ltd.	Aaa	Withdrawn

Source: European PPP Expertise Centre (2010). Capital markets in PPP financing.

Wrapped bonds financing faces a lot of problems resulting from the downgrades of monoline companies:

- Value impairment of wrapped PPP project bonds: wrapped PPP project bonds are rated by Moody using the higher rating of the underlying PPP project and the monoline companies. After the 2008 financial crisis, most monoline companies have been downgraded to the rating category ranging

from triple-B to single-A, and as a result, these PPP wrapped bonds are severely downgraded. (Moody, 2010).

- Problems resulting from the lack of transparency in some PPP project companies: in some cases, the underlying project does not have a public rating and little information is available to investors. In these cases, it is very difficult for institutional bond investors to value these bonds and the fund managers of these institutions are forced to sell bonds in this situation. This further decreases the value of these kinds of wrapped bonds. (Moody, 2010)
- Rating hurdle of institutional PPP project bond investors: traditionally, PPP project institutional PPP project bond investors, including pension fund and insurance companies only invest in the PPP project bonds with investment grades. Although PPP projects in construction are usually not rated in the investment grade or just in the lowest level of investment grade, the existence of monolines' guarantees makes the wrapped PPP project bonds attractive to these potential institutional PPP project bond investors by enhancing the rating of the wrapped PPP project bonds to be Aaa before the financial crisis. However, after the massive downgrades of monoline companies, these wrapped bonds hardly attract those institutional bond investors since their ratings usually fall below the rating hurdle of institutional PPP project bond investors. (Moody, 2010)
- Portfolio manager problem—lack of benchmark: before the 2008 financial crisis, wrapped bonds are usually rated in the Aaa range, and the performance of these wrapped PPP project bonds can be evaluated against the performance of other Aaa securities. These benchmarks are important for portfolio managers since their bonuses are usually calculated based on their comparative performance against certain standard benchmarks. Portfolio managers generally choose not to invest in those securities without certain standard benchmarks because their performance cannot be appropriately evaluated. After the 2008 financial crisis, wrapped bonds are largely downgraded and the performance of wrapped bonds cannot be evaluated against other Aaa securities. This makes portfolio managers reluctant to hold wrapped bonds since the performance of these wrapped bond investments cannot be evaluated against certain benchmarks. (Moody, 2010)

However, monolines can still provide effective project control even after the downgrade their rating:

- Provide effective project control after financial close: traditionally, the monoline companies provide the necessary project monitoring on behalf of PPP project bond investors before the 2008

financial crisis because they suffer a first loss if the underlying project doesn't go well. Even after the 2008 financial crisis, monolines still have incentives to control the project progresses and related decision making process since they are still in the first loss position.

4.7. Development of the Portuguese Pension Fund Market

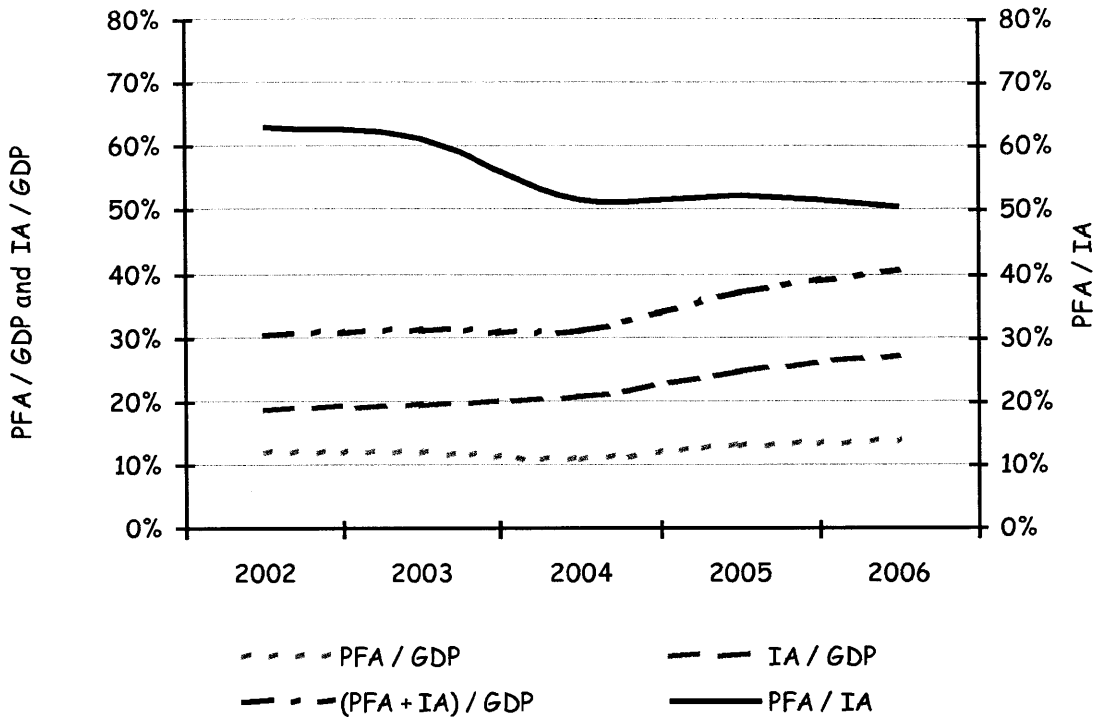
As discussed in the section *Overview of Bond Financing for PPP Projects*, pension funds and insurance companies are two of the most important types of PPP project bond investors. Therefore, it is very important to take a close look at the development of the Portuguese pension fund market.

4.7.1. Current Portuguese Pension Fund and Insurance Market

According to the statistics of the Portuguese Insurance and Pension Funds Supervisory Authority (ISP), the percentage of pension funds assets (PFA) in GDP increased from 10.6% in 2004 to 12.9% in 2005. On the other hand, the percentage of insurance assets (IA) in GDP increased from 20.6% to 24.7% over the same period. The combination of both pension fund assets and insurance assets accounted for around 38% of GDP by the end of 2005. The ratio of pension fund assets divided by insurance assets remained stable since 2004, ranging from 50% to 52%. (José Pavão Nunes, 2007) More details are provided in Figure 4-8 below. By comparison, in 2005 pension fund assets account for 0%, 3.9%, 5.8%, 9.1%, 18.8%, 58% and 66.2% of GDP in Greece, Germany, France, Spain, Australia, and the United Kingdom respectively. The Portugal's pension fund asset percentage is almost the medium of the percentages of OECD ³¹countries.

³¹ Organization for Economic Cooperation and Development

Figure 4-8 Pension Fund Market in Portugal



Source: José Pavão Nunes (2007). Pension fund in Portugal.

4.7.2. Social Security System Reform

Currently, ordinary state pensions in Portugal are financed through a redistribution system (pay-as-you-go³²). The rationale for this system is that the pension payments for current aged people come from the taxes or contributions of current workers, and the pension payments for tomorrow's aged people come from the taxes or contributions of tomorrow's workers. This redistribution system will face a lot of problems when the aged dependence index³³ increased rapidly, or in other words, when the percentage of aged people in the whole population increased rapidly, because the taxes or contribution burden of workers will become heavier and heavier. It is estimated that the aged dependence index will have

³² Definition of Pay as you go: In an unfunded defined benefit pension, no assets are set aside and the benefits are paid for by the employer or other pension sponsor as and when they are paid. Pension arrangements provided by the state in most countries in the world are unfunded, with benefits paid directly from current workers' contributions and taxes. This method of financing is known as Pay-as-you-go (PAYGO or PAYG). Source: http://en.wikipedia.org/wiki/Pension#cite_note-7

³³ The Aged Dependence Index is defined as the ratio Population 65 + / Population 15-64

increased from around 25% in 2005 to around 60% in 2050. (José Pavão Nunes, 2007) Therefore, this redistribution system is unsustainable in Portugal if no changes occur.

Portugal has realized this financial problems and has begun its Social Security System reform. Portugal would like to create a new system combining the current redistribution scheme and the capitalization scheme³⁴ together. This means that the government would like to put greater emphasis on the scheme in which every working person should contribute to the financing of their own pensions by creating capitalized financial reserves. (José Pavão Nunes, 2007) Based on the analysis of the upper trend of the percentage of aged people in Portugal, the transition from the redistribution system to capitalization system is expected to continue.

The change from the redistribution system to the capitalization system is definitely positive for the Portuguese pension fund market because this will significantly increase the total pension fund assets. The increase of the total pension fund assets will result in a more liquid capital market and create more demands for the assets pension fund would like to invest, for example, Aaa assets. On the other hand, if the retirement age of Portugal increases from 65 to 70, the ratio of aged people divided by working people will increase, and the transition progress from the redistribution system to the capitalization system will slow down.

4.7.3. Investments of Portuguese Pension Funds

Around 2006, Portuguese pension funds invest 58% of their total money in assets with an Aaa rating, and around 91% of their total money in assets with a rating superior to A is around 91%. (José Pavão Nunes, 2007) This shows that a high asset rating is essential for attracting Portuguese pension fund investments.

4.7.4. Conclusion of Portuguese Pension Fund Market

Although the current pension fund and insurance market size of Portugal is medium in OECD countries, this market is expected to grow significantly in the future because the current redistribution pension system is expected to gradually change to recapitalization system due to the pressure of the increase in the percentage of aged people in Portugal. This change is definitely a good opportunity for pension funds in

³⁴ In the capitalization scheme, every working person should also contribute to the financing of their own pension by creating financial reserves that are capitalized.

Portugal because it increases the total amount of pension fund assets, and it is also a good opportunity for Portuguese HSR building if it can achieve a high and attractive project rating to pension funds.

4.8. Institutional Structure Implication

From the analysis in the sections *PPP Project Rating, Wrapped Bond and Unwrapped Bond, Bank Loan & Bond Market for PPP Projects, and Wrapped Bonds after the Financial Crisis*, we can conclude that compared to unwrapped bonds, wrapped bonds before the financial crisis could achieve much lower financial cost, overcome rating hurdle of institutional PPP project bond investors, close the rating gap between PPP project ratings in the construction phase and operation phase, provide effective project control after financial close, and ease the worry of PPP project bond investors on the transparency of PPP projects.

Compared with bank loans, wrapped bonds before the financial crisis could achieve lower total financial costs, longer financing term, lower refinancing cost, and less lender-borrower negotiation cost.

However, during the financial crisis, due to the exposure on asset-backed securities for which the underlying assets were the sub-prime or other non-standard United States mortgage loans, the rating of monoline companies decreased a lot and the effectiveness of this monoline insurance wrapped bond model was severely impaired.

Therefore, we think it will bring a huge amount of benefits if the Portuguese government can develop a debt guarantee program at a national level, the function of which is just like monoline guarantees, and form a corresponding new institution to support this program (the new institution is the Portuguese Infrastructure Bank, and details will be given in Section 4.8.4). This program will help significantly lower the financial cost of Portuguese High-Speed Rail building if wrapped bond financing is used.

In addition, this debt guarantee program at a national level may bring in higher than expected benefits because the total Portuguese pension fund asset will probably increase and infrastructure bonds, including the potential HSR project bonds, will face more demands if these bonds can achieve high enough rating: Portugal is highly likely to continue its Social Security System reform and gradually change its current redistribution pension system to recapitalization system due to the pressure of the increase of aged people in Portugal, which will result in the increases of pension fund assets.

This institution used to support the debt guarantee program at a national level should be able to collect a guaranteed fee at a market price and have financially sustainable development: this financially sustainable development is totally possible since firstly the traditional monoline companies were profitable before the financial crisis; secondly the downgrade of monoline companies in the financial crisis was not due to their exposure to asset-backed securities for which the underlying assets were infrastructure bonds, but the exposure to asset-backed securities for which the underlying assets were the sub-prime United States mortgage loans.

To better understand what kinds of institutions are appropriate, we take a close look at related financially sustainable institutions which provide guarantees, including the European Investment Bank (EIB), and the proposed United States Infrastructure Bank.

4.8.1. European Investment Bank

“Established under the treaty of Rome in 1957 and created in 1958, the European Investment Bank (EIB) is the European Union (EU)'s long-term lending institution. As a policy-driven Bank, the EIB supports EU priority objectives, notably European integration and social cohesion, through its financing operations.” (EIB, 2011f)

The business model of the EIB is that it finances viable capital projects matched up with the EU objectives and borrow low on the capital markets to finance these projects using its Aaa rating. The total capital of the EIB in the end of 2009 was 232 billion Euros, of which 11.6 billion Euros were actually paid-in. In other words, the ratio of total capital divided by public capital was close to 20. (EIB, 2011g)

In the EU, the EIB would like to lend to six kinds of projects: Cohesion and Convergence; Support for small and medium-sized enterprises (SMEs), Environmental Sustainability, Implementation of the Innovation 2010 Initiative (i2i), Development of Trans-European Networks of transport and energy (TENs), Sustainable, competitive and secure energy. (EIB, 2011a)

The financial products EIB provides include loans, technical assistance, guarantees, venture capital, and microfinance. (EIB, 2011b) The loans include individual loans provided directly to projects with capital cost larger than 25 million Euros and being in line with the EU objectives, and intermediated loans provided to banks and financial institutions to help them to provide finance to small and medium-sized enterprises. (EIB, 2011c) The guarantee can be either a standard guarantee or debt service guarantee

similar to that offered by monoline insurers. For TEN-T projects, including the Portuguese HSR projects, the Loan Guarantee Instrument for TEN Transport (LGTT) can be very helpful, which is designed to guarantee revenue risks during a limited period following construction of TENs projects, notably under a PPP structure. (EIB, 2011d)

The most important corporate policy of the EIB is its transparency policy. (EIB, 2011a) The EIB group “stresses good governance, including a high level of transparency and accountability for itself and its counterparts, while recognizing the need to respect confidentiality where appropriate and ensuring trust. The EIB considers that as a bank and a public institution, openness on how it makes decisions, works and implements EU policies, strengthens its credibility and its accountability to citizens. Transparency also contributes to increasing the efficiency and sustainability of the Bank’s operations, reducing the risks of corruption, and enhancing staff relations with external stakeholders.”

4.8.2. The US Infrastructure Bank (Proposed)

The creation of the US Infrastructure Bank was recently proposed by Senator Christopher J. Dodd and Senator Chuck Hagel in 2007 in their Dodd-Hagel bill (S.1926 and HR.3401). The bank was proposed to be established using a \$60 billion long-term bond issue (up to 50 years) and pay back these bonds using the potential benefits of the bank’s infrastructure investments in the future. The bank was estimated to be self-financing in the end. (Kenneth Orski, 2008)

The US Infrastructure Bank is supposed to promote the building of infrastructure projects--primarily roads, mass transits and High-Speed Trains—in line with public interest, including economic growth, environmental sustainability, regional integration, poverty alleviation, etc. by using its toolbox of loans, insurance policies and guarantees to stimulate the use of public private partnerships. (Michael Likosky, 2010) This US Infrastructure Bank is supposed to achieve the best use of federal resources since it will evaluate projects on a project-by-project, and dollar-by-dollar basis. (Everett Ehrlich & Felix G. Rohatyn, 2008)

The business model of the US Infrastructure Bank was discussed in details in HR. 2521. According to the summary of HR. 2521, the revised bill “ Authorizes the Board to: (1) issue public benefit bonds and provide direct subsidies to infrastructure projects; (2) borrow on the global capital market and lend to entities and commercial banks for funding infrastructure projects; and (3) purchase, pool, and sell infrastructure-related loans and securities (including guarantees) on such market. Requires the Board to

establish criteria for determining project eligibility for financial assistance under this Act." (GovTrack.US, 2011)

The most important financial related concept of the US Infrastructure Bank is leverage. Chairman Dodd explained to the hearing in 2007 "this bank would establish a unique and powerful public-private partnership. Using limited Federal resources, it would leverage the significant resources and innovation of the private sector. It would tap the private sector's financial and intellectual power to meet our nation's largest and most critical structural needs." Senator Hagel went on to explain to the hearing: "The Infrastructure Bank-a public entity similar in nature to the Municipal Assistance Corporation- would have the ability to leverage private capital to supplement current levels of public spending. A public entity that can focus private sector investment onto public infrastructure could help provide the necessary investment for 21st century infrastructure in America." (Michael Likosky, 2010)

In 2008, President Obama suggested that the Bank would borrow US\$60 billion of federal funding to invest in infrastructure over 10 years, while leveraging "up to \$500 billion" of private investment.

Everett Ehrlich and Felix G. Rohatyn (2008) also argued "even using a conservative ratio of borrowed funds to capital of three to one (meaning each dollar of federal activity attracts three added dollars of private borrowing), this could produce almost a quarter trillion of investment on a \$60 billion annual bond issue."

4.8.3. Comparison of European Investment Bank and the Proposed US Infrastructure Bank

After comparing the cases of the EIB and the proposed US Infrastructure Bank, we can conclude that these two banks both provide loans and guarantees to support the development of infrastructure projects in line with public interest. HSR projects, included in "TEN-T for EIB and HSR trains for the proposed US Infrastructure Bank", are important investment targets for both of them.

Both EIB and the proposed US Infrastructure Bank are, or are supposed to be, financially sustainable. The basic business models of these two banks are also almost the same: they borrow low in the global capital market and provide infrastructure-related loans and securities to entities and commercial banks for funding infrastructure projects, except for the facts that the proposed US Infrastructure Bank also

purchase, and pool these infrastructure-related loans and securities (including guarantees) in this capital market, and issue public benefit bonds and provide direct subsidies to infrastructure projects.

Leverage is the most important financial concept for both the EIB and the proposed US Infrastructure Bank: in the EIB, the ratio of total capital divided by public capital was close to 20 in 2009; in the proposed US Infrastructure Bank, the proposed ratio of total capital divided by public capital is 500 billion USD/60 billion USD, or close to 9.

Although we don't know whether the proposed US Infrastructure Bank can succeed in the future since it has not been created, we do know the key factor for the success of the EIB is its Aaa rating: because of its Aaa rating, it can borrow at a very low interest rate and is able to be financially sustainable. However, although not explicitly listed in documents, someone can argue that the EIB's achievement of Aaa rating is due to the implicit guarantees provided by the EU.

4.8.4. Conclusion of Institutional Structure Implication

As previously discussed in *Institutional Structure Implication*, the Portuguese government can benefit significantly by developing a debt guarantee program at a national level, the function of which should be similar to the function of monoline companies. This program will significantly lower the financial cost of Portuguese High-Speed Rail building if wrapped bond financing is used this way. To support this program, the Portuguese government should form a corresponding new institution (the proposed new institution is the Portuguese Infrastructure Bank, and details will be given soon in this section). After taking a close look at both the EIB and the proposed US Infrastructure Bank, we can conclude:

- These two banks are both created to support the development of infrastructure projects in line with public interest and they are both interested in HSR projects;
- They achieve or are supposed to achieve a high financial leverage and make full use of private capital;
- They both provide guarantees to the building of infrastructure projects: the EIB provides both the regular guarantees and monoline guarantees, and it is still not clear whether the proposed US Infrastructure Bank will provide these monoline guarantees;
- The business models of these two banks are almost the same: they borrow low in the global capital market and provide infrastructure-related loans and securities to entities and commercial banks for funding infrastructure projects;

- The EIB has achieved financial sustainability mostly because it can maintain its Aaa rating and invest mostly in financially viable projects.

It is beneficial for the Portuguese government to establish a national infrastructure bank to support the development of Portuguese infrastructure, including its HSR developments. This bank should have a high rating like EIB, e.g. Aaa, and be able to borrow low in the global capital markets. If the Portuguese government can achieve a high rating, such as Aaa, in the future, this Portuguese infrastructure bank can benefit from receiving guarantees from the Portuguese government or becoming a subsidiary of the government. However, if the Portuguese government cannot achieve a high rating in the future, for example, if the government can only get rated Baa1 as it did in April, 2011, this national infrastructure bank should be private and should not be just a subsidiary of the Portuguese government. Otherwise, this national infrastructure bank will meet a rating ceiling, which is the rating of the Portuguese government. In the second case, the Portuguese government needs to allocate a significant amount of capital and few debts to the national infrastructure bank to help it achieve a much lower debt to capital ratio than the one of the Portuguese government. At the same time, the Portuguese government should have absolute control over the Portuguese infrastructure bank by holding more than 51 percentage of the total equity. In either of these two cases, it would definitely be helpful if the Portuguese Infrastructure Bank can get some financial support, including guarantees, fund injection and so on, from the EIB or from the EU.

The Portuguese infrastructure bank should provide loans or guarantees to projects in line with public interest. At the same time, it should also pay special attentions to financial viability when selecting investment projects, in order to make its business financially sustainable. Compared to the EIB and the proposed US Infrastructure Bank, the Portuguese infrastructure bank should focus more on the monoline guarantee business since it is the most promising, and cheapest financing method both before the financial crisis and in the future, and it can bring most benefits to the infrastructure development in Portugal. The fees should be set at market prices and the infrastructure bank should be able to generate profits based on it. In addition, the Portuguese infrastructure bank should treat transparency very seriously since it has been proved to be a very key factor for the success of this infrastructure bank.

In the end, we should point out that none of these conclusions works without the economy of Portugal getting healthy.

4.9. Other Innovative Financing Methods: Stock IPO, Co-lending, etc.

4.9.1. Stock IPO

According to the experience of China, Germany, Taiwan, Japan and Portugal discussed in Chapter 3, *Difference between Financing HSR and Other Transportation Projects*, whether stock IPO is feasible for HSR project financing depends heavily on the project's profitability. Generally speaking, stock IPO is infeasible for HSR project financing because HSR projects are generally not profitable. The only exception is Japan, in which some HSR projects are very profitable.

For Portugal, stock IPO can be used to gather money for HSR projects probably only when the government is willing to give tax incentives, just as Taiwan did.

In Taiwan, the tax incentives were stated as: "For those entities/people who hold the stocks of domestic major transportation projects or significant infrastructures for more than two years, these entities/people can claim 20% of their investments as deductibles from taxable income, starting from year 2." (I-Tsung Tsai, 2007)

4.9.2. Co-lending

If the Portuguese government would like to use the unwrapped bond financing, the underlying project rating matters a lot.

As discussed early, the public capital contributions at the beginning are considering negative in Moody's rating if these capital contributions are paid progressively and based on the degree of project completion. To avoid the negative rating effect of public capital contribution at the beginning, Portuguese government can consider using co-lending instead of public capital contribution.

These kinds of governmental co-lending agencies have already existed in the world, for example, the HM Treasury's The Infrastructure Financing Unit (TIFU) in the UK. According to Moody (2009), "if this public sector co-lending is provided for the long-term, with no expectation of replacement, and with the co-lending ranking equal with conventional private sector debt, we may even view such co-lending as a credit positive on the grounds that the public sector off-taker may be less willing to allow private sector lenders to reach a default if that inevitably causes a simultaneous default on the public sector's co-lending asset."

Therefore, we can see if the Portuguese government is willing to provide this co-lending for the long-term, with no expectation of the replacement and with co-lending ranking equal with conventional private sector debt, it can enhance its HSR project rating.

4.10. Conclusion

Compared to unwrapped bonds, bank loans, and stock IPO, wrapped bonds guaranteed by high rating monolines are the most promising way to finance the Portuguese HSR projects in the future because of its low total financial costs, long financing term and low refinancing cost. However, the effectiveness of the wrapped bond model has been limited by the 2008 financial crisis because most monolines have been downgraded a lot since then.

To recover the benefits of wrapped bonds and to better use them to finance the building of Portuguese HSR projects in the future, the Portuguese government needs to develop a national debt guarantee program, the function of which should be similar to the function of monoline companies. To support this program, the Portuguese government needs to establish a high rating national infrastructure bank. The Portuguese infrastructure bank should provide loans or guarantees to infrastructure projects in line with public interest just as EIB and Obama's Bank do, but it should focus more on the monoline guarantee businesses because wrapped bond financing is the most effective way to finance the Portuguese HSR projects in the future. In this end, we need to point out again that this conclusion only works when the economy of Portugal has become much better and can really afford to build a new HSR project.

5. Megaregions and HSR Financing

5.1. Overview

In Chapter 4, *Innovative Financing Methods*, we conclude that the wrapped bond is a very promising way to finance the Portuguese HSR projects in the future since it has much lower total financial costs than unwrapped bonds and bank loans when this wrapped bond can be rated Aaa. We recommended that the Portuguese government should establish a debt guarantee program at the national level to support the revival of wrapped bonds after the 2008 financial crisis has passed. Institutionally, we think a national infrastructure bank is an appropriate institution to provide this nation-wide debt guarantee program.

However, the use of innovative financing methods cannot diminish the importance of a “good project”, or financially viable project: innovative financing methods are used to decrease financial costs required by investors because of their unfamiliarity with projects, but these methods cannot change the intrinsic financial value of the projects; if the projects cannot generate enough operating revenues or operating cash flows in the future, no innovative financing methods, including wrapped bonds, can work. A good project, or a financially viable project, is the foundation for using any innovative financing methods. This relationship can be illustrated in Figure 5-1:

Figure 5-1 Relationship between Innovative Financing Methods and Financially Viable Projects



Source: sketched by the author

The Portuguese HSR projects are all important megaregion projects: for example, the Lisbon-Oporto HSR line links the two largest metropolitan areas in Portugal, Lisbon and Porto. In this chapter, we will take a close look at the megaregion characteristics of the Portuguese HSR projects, identify potential megaregion revenues based on hoped economic growth, and provide recommendations for the Portuguese HSR financing based on these new identified revenues.

This chapter can be divided into four sections: in the first section, we introduce the concept of megaregions and briefly discuss the relationship between megaregions and the internal transportation infrastructures; in the second part, we summarize the theories of HSR's contribution for the formation of megaregions; in the third section, we discuss the economic influence of HSR on megaregions; in the fourth section, we discuss the potential megaregion revenues that we can use to build HSR.

5.2. Megaregions

5.2.1. Definition for Megaregions

Generally speaking, megaregions are regions with large agglomeration of economic activities. There are many terminologies expressing the same meaning with megaregions: all megalopolises, metropolitan areas, and function region are similar to megaregions.

Blum, Haynes, Karlsson (1997) defines the function region as “a geographical area that shares a common labor market and a common market for household and business services”.

Regional Plan Association (2006) defines megaregions as “agglomerations of metropolitan regions with integrated labor markets, infrastructure, and land use systems”.

Ross (2009) defines megaregions as “network of metropolitan centers and their surrounding areas. They are spatially and functionally linked through environmental, economic, and infrastructure interactions.”

For consistency, we will just use the term megaregions in the following discussion.

The formation of megaregions is based on the Modern City Theory: “No city is an island, not economically, not environmentally, not demographically, not culturally and certainly not politically. A thriving city both draws from and contributes to a thriving region.” (Ross, 2009)

Eduardo Lopez Moreno, the co-author of the UN report, *World's Biggest Cities Merging Into Megaregions*, said "Research shows that the world's largest 40 megaregions cover only a tiny fraction of the habitable surface of our planet and are home to fewer than 18% of the world's population [but] account for 66% of all economic activity and about 85% of technological and scientific innovation." (John Vidal, 2010)

The largest current megaregions in the world are the Hong Kong-Shenzhen-Guangzhou regions in China, the population of which is about 120 million. (John Vidal, 2010) In the US, approximately 70% of the population will reside in or close to the country's eight or ten megaregions. (Ross, 2009) In Portugal, the population of the urbanized area of Lisbon is about 3 million (Demographia, 2011), and the population of the Porto metropolitan area is about 1.1 million (Demographia, 2011), if megaregions can be formed in the Lisbon-Porto areas, the megaregions will have a population of at least 4.1 million.

5.2.2. Megaregion Governance and Planning

Ross (2009) considers megaregions, not cities, to be the most appropriate unit of social organization and economic coordination. She thinks that megaregions may be more effective than cities to absorb the economic shock waves of economic crises, and allocate limited resources to meet the social and economic challenges. She also thinks megaregions are the best unit to capture the economies of scale effect associated with the building of large infrastructure projects. (Ross, 2009) Ross and Woo (2011) also argues that megaregions play an important role in globalization by providing "focal points for global connections to existing and emerging markets of opportunities". Therefore, the importance of megaregions requires us to take a close look at megaregion governance and planning.

According to Innes, Booher, and Vittorio (2010), due to the lack of integrated megaregion governance, "formal government decisions are made at different scales, typically without consultation with those who will be affected and usually without coordination, much less an effort to achieve joint gain." This lack of coordination between formal governments resulting that "megaregions (are) unable to build synergies among diverse components, adapt to changing conditions in a productive way, or address region-wide issues."

At the same time, Contant (2009) also argues that planning carried by local governments will meet problems when facing the challenges of globalization, uneven distribution of wealth, global climate change, limited natural resource, etc. This is because that these issues are all at least at the regional scale

while local governments act to maximize the local benefits only. Local governments have incentives to promote activities that increase local wealth even when these activities can result in external diseconomies, because the funding of local governments is typically only related to local property values and the wealth of local citizens. (Ross, 2009) Although no individual scale of planning can fully address the challenges mentioned above, Regional Plan Association (2006) argued that “planning at the scale of megaregions may provide useful approaches to enhance future economic competitiveness, sustainability, and quality of life.”

Therefore, the literature shows that megaregion governance and planning is more effective in addressing the challenges we face in the 21st century, including global climate change, limited natural resources and so on. The megaregion governance and planning helps to utilize both energy and land resources more effectively and efficiently, because it internalizes the external diseconomies of local planning and reaches closer to the global optimum.

However, it is infeasible to achieve megaregion governance and planning by forming a formal megaregion government, “given the limited success thus far of metropolitan governments”. (Innes, Booher, and Vittorio, 2010) To address this issue, based on the research results of complexity science, Innes, Booher, and Vittorio (2010) proposes “the use of collaborative network governance in megaregions in the current set of governing institutions, which interfere with collaboration, boundary spanning, and inclusion of diverse players.” More specifically, their idea is to form systems of governance in megaregions including “not only governments and public agencies, but also profit and nonprofit entities, civic organizations and representatives of a larger public”, and to build linkages between these different fragmented systems. Based on the adaptive complex system theory, because these complex systems are diversified, interactive, and able to select, these complex systems can “select effective strategies and those with low-value outcomes.” (Innes, Booher, and Vittorio, 2010)

5.2.3. Megaregion and Transportation Project Investments

Transportation investments are extremely important for megaregions and the whole nation. Meyer (2007) argues: “The transportation connections within megaregions will need particular attention in that these connections not only support the economic activities of the megaregions themselves, but also serve as gateways to the rest of the nation.” Ross and Woo (2011) argues “sustainable, livable megaregions require intra- and inter-urban access and mobility coordinated with public transportation.” On the other hand, the megaregions concept should be considered seriously in transportation investments. Ross (2009)

states “extending transportation and infrastructure planning to the level of the megaregions could deliver significant economic, social, and mobility benefits.”

In addition, according to Ross and Woo (2011), “to relieve traffic congestion in major corridors in megaregions, mobility systems should be based on alternative modes of transportation and combinations of different modes and technologies.” To maximize the benefits of the whole megaregions, they suggest that the US government builds more sustainable infrastructure and transportation system in megaregions, for example, the High-Speed Rail system, which can “improve mobility, environmental conditions, and regional economic growth and connectivity and ensure the integration of transit in long-range and regional policies”.

We can conclude that the transportation investments in megaregions help with the regional economic development significantly. And HSR is a sustainable mode that people should prefer when considering megaregion development. We will take a close look at HSR’s contributions to the economy of megaregions in the following sections *HSR and Megaregion Formation*, and *HSR’s Economic Influence on Megaregions*.

5.3. HSR and Megaregion formation

5.3.1. Overview of HSR and Megaregion Formation

The HSR’s contributions to the formation of megaregions have been discussed significantly by many authors.

According to Blum, Karlsson and Haynes (1997) “HSR links together many cities and, hence, creates a new type of region or corridor with a high interregional accessibility... cities that are linked together into a band of cities by means of a High-Speed Train connection are transformed to an extended functional region or in other words an integrated corridor economy.”

According to Hall (2009), “railway systems have achieved an extraordinary renaissance in the form of High-Speed Trains.... (HSR) shrink geographical space, and thus tie not only half of Britain, but also much of Europe, into a single polycentric Megalopolis.”

According to Vickerman (1997), “High-Speed Rail improves both the competitiveness and cohesion dimensions by, in effect, shrinking the size of geographical space” by increasing accessibility. However, “it is clear that the biggest gains in accessibility accrue to the major access points to the network.”

According to Melibaeva, Sussman, and Dunn (2010), “HSR contributes to further centralization and concentration of most economic activity in already developed areas.”

In summary, HSR decreases the temporal distances and increase the accessibility between cities, “shrinks the size of geographical space”, and therefore may contribute to the formation of megaregions. However, we should also notice that the gains from HSR investments are not distributed evenly across the whole megaregions, with the major access points, and the already developed areas usually being the biggest winners.

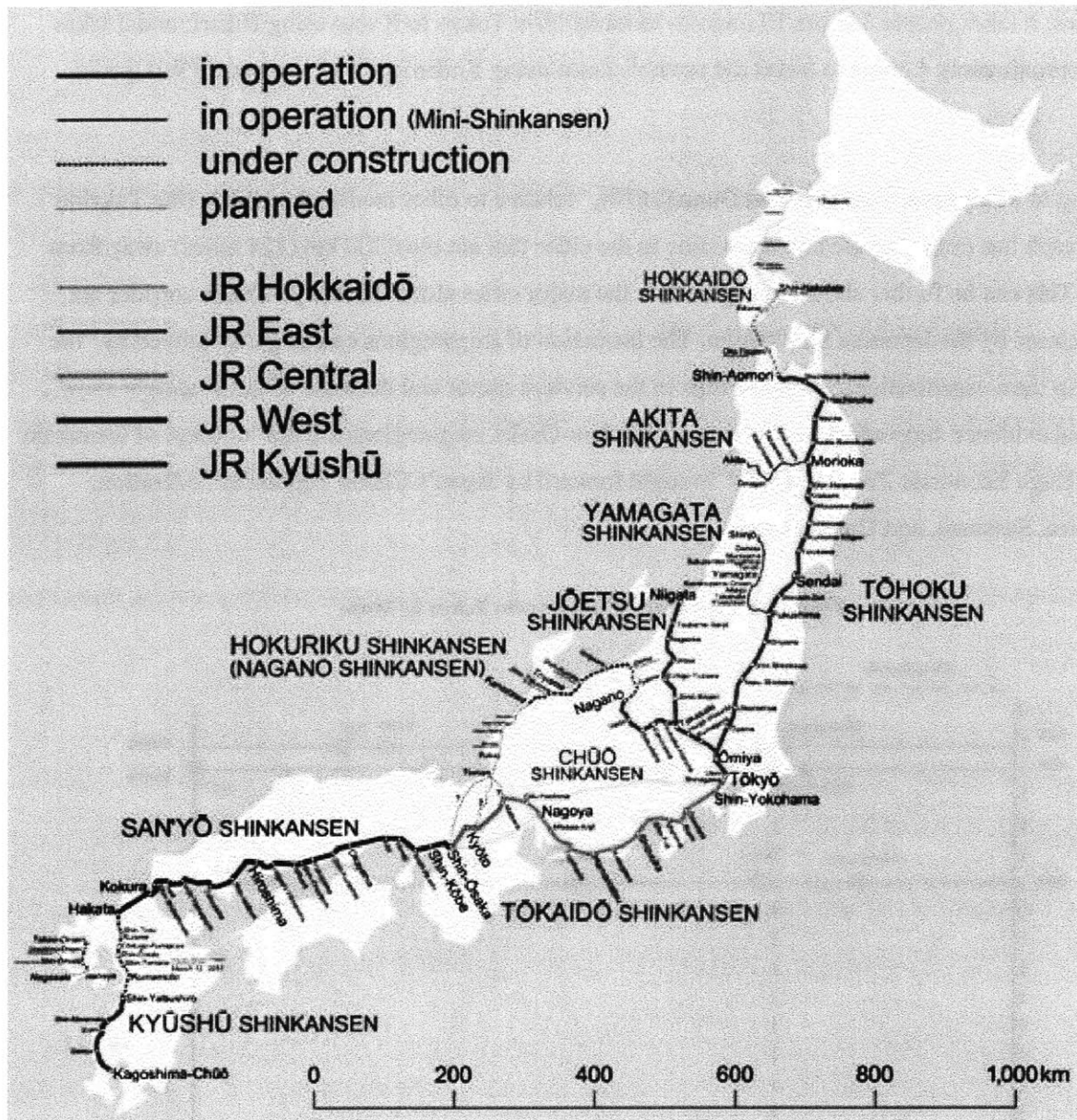
According to Blum, Haynes, and Karlsson (1997), the contributions of HSR to the formation of megaregions can be in two cases: in the first case, megaregions are only formed between the two principal end cities “when a point to point link is dominant” and “each train is a potential substitute for an air connection between two cities”; in the second case, megaregions are formed by binding cities along the HSR lines when “the train system links together many cities and CBD’s and, hence, creates a new type of region with a high intra-regional accessibility.” (Blum, Haynes, and Karlsson, 1997)

In addition, to measure HSR’s contributions to the formation of megaregions, Melibaeva, Sussman, and Dunn (2010) propose the use of “daily accessibility indicators” since “HSR allows reaching more population and more places at a reduced travel time relative to other modes of transportation”. After HSR investments, they expect to see “significant increases in one-day round trips between a pair or group of cities, high levels of newly generated induced demand overall, induced demand for business trips, increase in the number of daily commuters, and decrease in overnight hotel stays.”

5.3.2. The Japanese Shinkansen and the Formation of Megaregions

The Shinkansen is the High-Speed Rail network in Japan. Important Shinkansen lines include Tokaido Shinkansen, Sanyo Shinkansen, Joetsu Shinkansen, Tohoku Shinkansen, Hokuriku Shinkansen, Yamagata Shinkansen, Akita Shinkansen, Hokuriku Shinkansen and so on. The map of the Japanese Shinkansen network is shown in Figure 5-2.

Figure 5-2 Map of the Japanese Shinkansen Network in 2010



Source: Wikitravel (2011). Retrieved Feb, 2011 from http://wikitravel.org/en/Image:Shinkansen_map_20101204_en.png

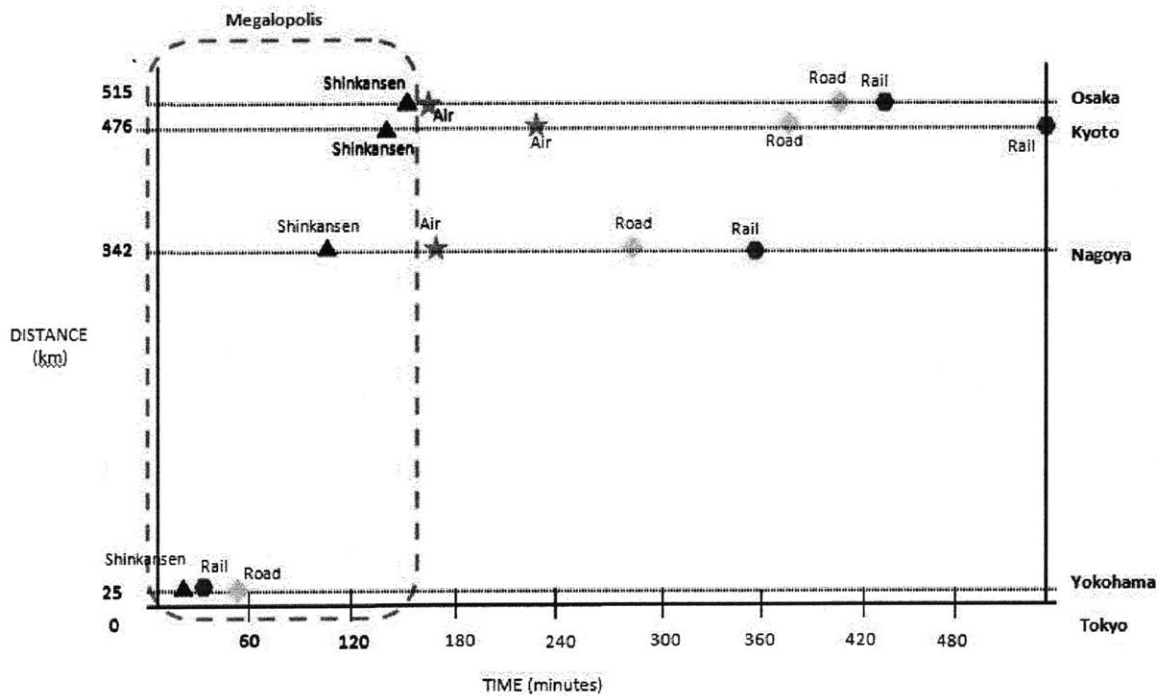
The Tokaido line, opened in 1964, is the first Shinkansen line linking Tokyo and Osaka, was operated by JR Central. (Sand, 1993) Nowadays, the Tokaido line is the busiest HSR line in the world, with 151 million passengers transported by it per year (March 2008). (Melibaeva, Sussman, and Dunn, 2010)

The Tokaido line links 17 stations, including Tokyo, Shinagawa, Shin-Yokohama, Nagoya, Kyoto, Shin-Osaka and so on. There are three types of trains running on this HSR line, Nozomi, Hikari, and Kodama.

The Nozomi, the fastest one, shortens the temporal distance between Tokyo and Kyoto to be just 2 hours 30 minutes; it takes people 3 hours 10 minutes to travel from Tokyo to Kyoto using Hikari; and it takes people approximately 4 hours to travel the same distance using Kodama, the slowest one. (Wikipedia, 2011a)

According to Melibaeva, Sussman, and Dunn (2010), “relative to other modes, the HSR’s (the Tokaido HSR’s) reach has expanded the commute zone to the cities that are over 200 km (124 miles) away from Tokyo.” This can be further shown in Figure 5-3: the major cities along the Tokyo-Osaka corridor are brought closer by the Japanese Shinkansen. The formation of megaregions can be partly proved by “the increase in intra-organizational business trips in the services sector and decrease of the overnight stays”. Additional evidence supporting the formation of Tokyo-Osaka megaregions are the “concept of formation of Extra Huge Economic Zones (EHEZ)” brought forward by Japan’s Chubu Economic Federation. (Melibaeva, Sussman, and Dunn, 2010)

Figure 5-3 Time Space Chart from/to Tokyo by Mode



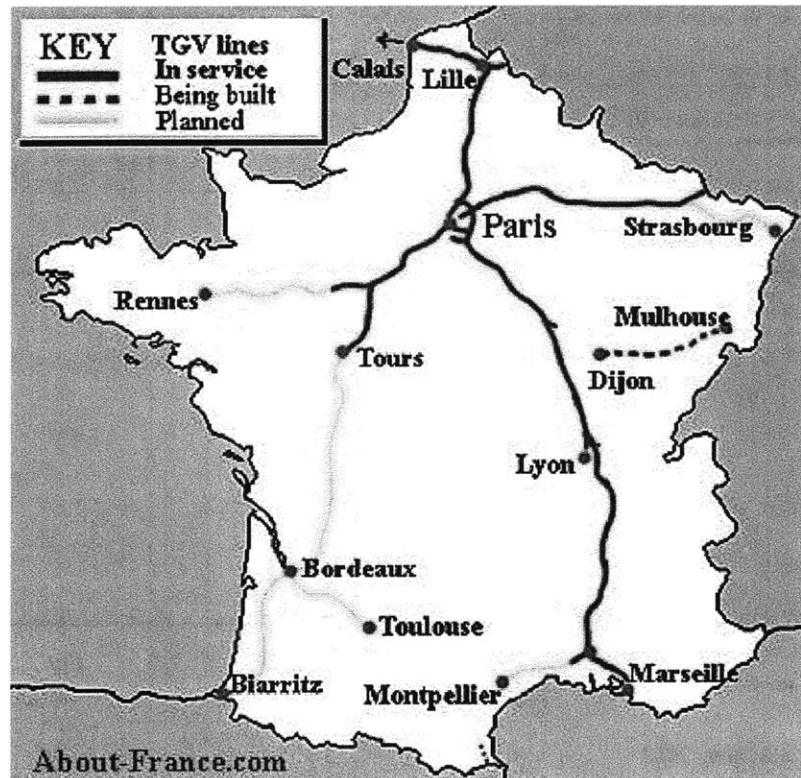
Source: Melibaeva, Sussman, and Dunn, 2010

According to Blum, Haynes, and Karlsson (1997), the Tokyo-Osaka megaregions are only formed between the two principal end cities, Tokyo and Osaka, not with others. Furthermore, this means cities along the corridor of HSR line may experience a loss of economic activities.

5.3.3. The French TGV and the Formation of Megaregions

The French TGV, the HSR network in France, is basically radial with its center being in Paris. The French TGVs include the Paris-Lyon TGV, the TGV Atlantic line (Paris-Le Marts/Tours), the Paris Lille TGV, and so on. The map of the French TGV network is illustrated in Figure 5-4.

Figure 5-4 Map of the French TGV Network in 2010



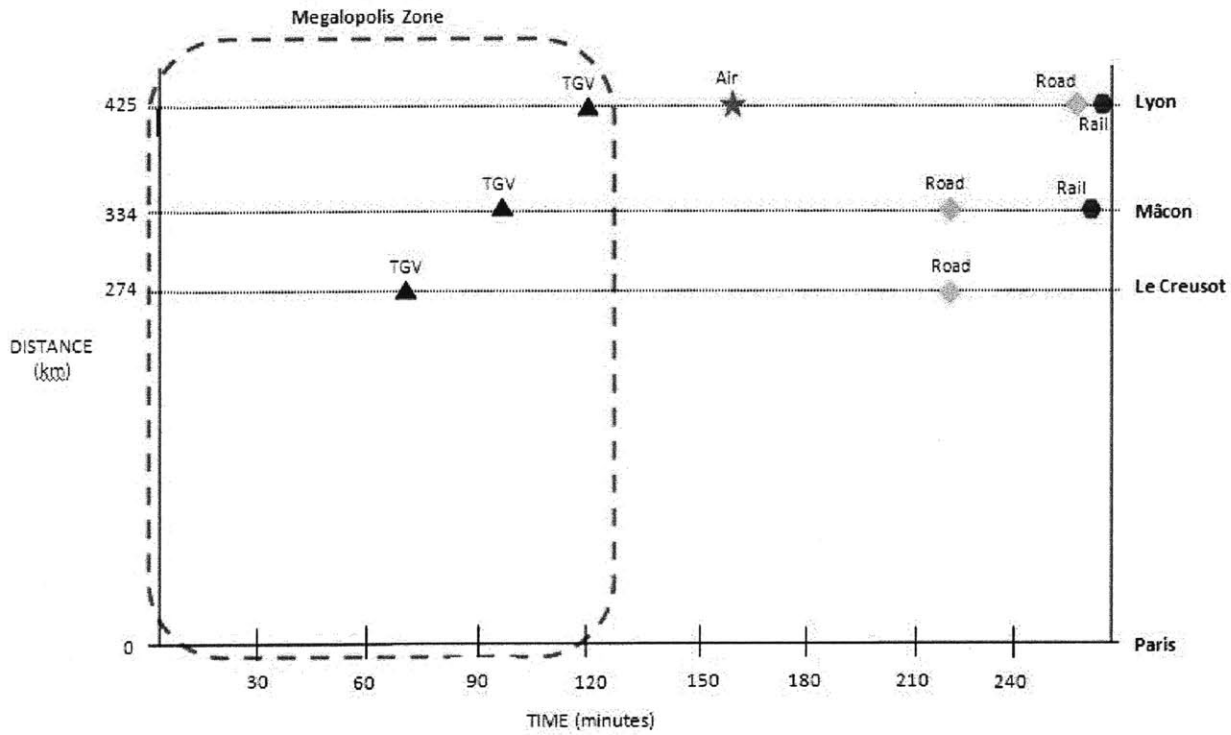
Source: About France.com, Retrieved Feb, 2011 from <http://about-france.com/france-rail-travel.htm>

The Paris-Lyon HSR, launched in 1981, is the first TGV line in France. This Paris-Lyon HSR shortens the temporal distance between Paris-Lyon to be two hours (the physical distance between these two cities is 425km).

According to Melibaeva, Sussman, and Dunn (2010), the Paris-Lyon TGV brought the two largest urban centers in France, Paris and Lyon, closer to each other, as shown in Figure 5-5. “Total business travel on the corridor increased 56%, and those made for sale/purchase of services by 112%.” “The number of overnight stays by TGV passengers fell after the introduction of HSR from 74 to 46%”. The increase of business travel, especially those made for the sale/purchase of services, provides strong evidence for the

increase of induced travel. Combining this increase of induced travel and the decrease of overnight stay, we can conclude that the Paris-Lyon TGV shrinks the geographic distance between Paris and Lyon, and this HSR line helps with the formation of the Paris-Lyon megaregions. (Melibaeva, Sussman, and Dunn, 2010)

Figure 5-5 Time Space Chart from/to Paris by Mode



Source: Melibaeva, Sussman, and Dunn, 2010

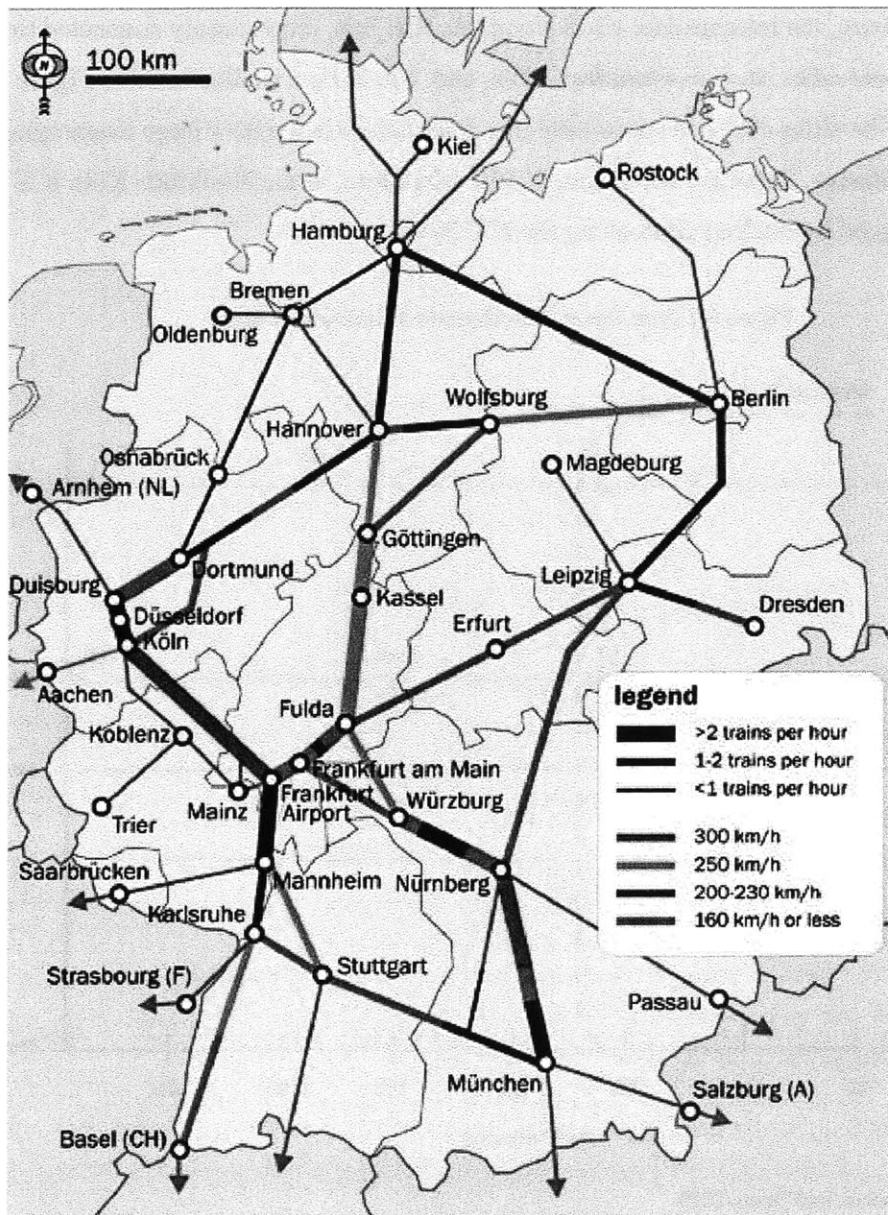
However, it should also be noted that intermediate cities along the HSR line, Le Creusot and Macon, have not experienced the gigantic changes of users' behaviors like Paris and Lyon due to the low frequencies of HSR trains in these cities (8 vs. 30 trains/day in Paris). (Melibaeva, Sussman, and Dunn, 2010) This means that the Paris-Lyon megaregions are only formed between the two principal end cities, Paris and Lyon, not with others. Furthermore, this Paris-Lyon HSR case shows that cities along the corridor of HSR line may experience a loss of economic activities.

5.3.4. The German ICE and the Formation of Megaregions

The German ICE trains are operated in a maximum speed of 300 km/h (186 mph) and connect major German cities at hourly intervals. The major ICE lines includes the Frankfurt-Hamburg ICE line, the

Frankfurt-München (Munich) ICE line, the Hamburg-München ICE line, the Berlin- Frankfurt ICE line, the Frankfurt- Köln ICE line, the Frankfurt-Amsterdam ICE line, the Frankfurt-Brussels ICE line, the Berlin-Hamburg ICE line, the Hamburg-Copenhagen ICE line, and so on. (EuRail, 2011) The map of the German ICE network in 2010 is illustrated in Figure 5-6.

Figure 5-6 Map of the German ICE Network in 2010

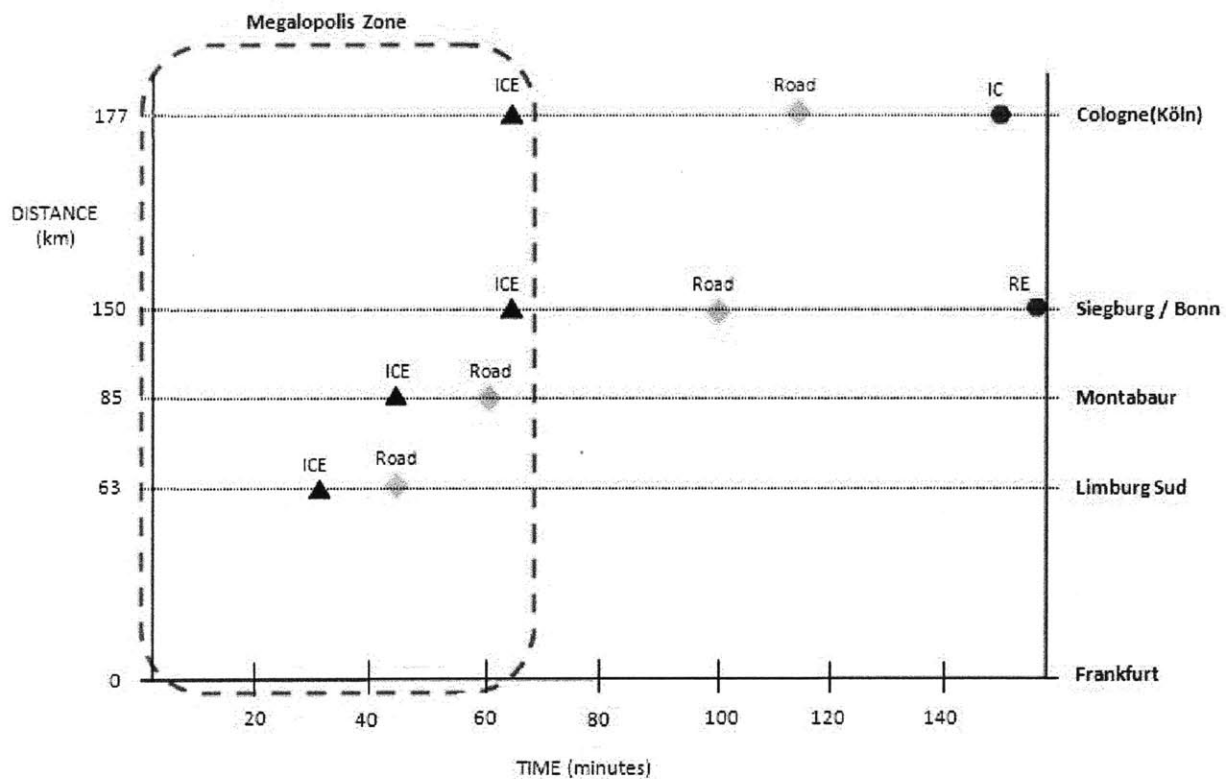


Source: Wikipedia.2011. Intercity-Express. Retrieved Feb 20th, 2011 from <http://en.wikipedia.org/wiki/Intercity-Express#Germany>

The Frankfurt- Köln ICE line is the first new-built (contrasted with upgraded) dedicated ICE line linking the cities of Frankfurt am Main and Köln, with a total distance of 177km (110 miles). This ICE line has shortened the temporal distance between these two cities from 2 hours 15 min to just over an hour. (Sasaki, Ohashi, and Nado, 1997)

According to Melibaeva, Sussman, and Dunn (2010), the deployment of the Frankfurt- Köln ICE makes Montabaur and Limburg, the intermediate cities along this ICE line, more closely connected to the traditional employment cities, such as Frankfurt, Köln, and Wiesbaden, as illustrated in Figure 5-7. “The ICE line has moved the cities closer in space-time thus integrating them into a large megaregion or megalopolis.” (Melibaeva, Sussman, and Dunn, 2010). Therefore, in the Frankfurt- Köln ICE case, megaregions are formed by binding cities along the ICE lines.

Figure 5-7 Time Space Chart from/to Frankfurt by Mode



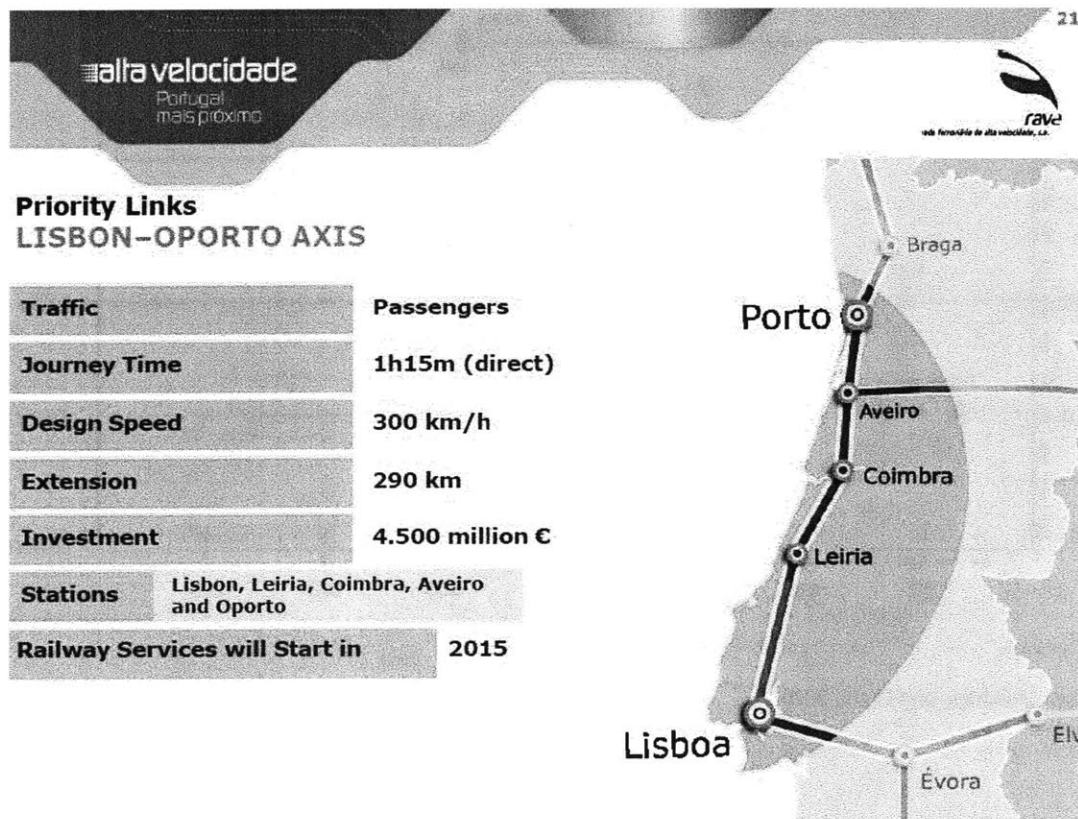
Source: Melibaeva, Sussman, and Dunn, 2010

5.3.5. The Lisbon-Porto HSR and the Potential Formation of Lisbon-Porto Megaregions

According to RAVE, the Portuguese government plans to build the Lisbon-Porto HSR in 2015, a 297 km HSR line linking the cities Lisbon, Leiria, Coimbra, Aveiro, and Porto. (RAVE, 2008) This HSR line will shorten the temporal distance from Lisbon to Porto to only 75 min. The map of this Lisbon-Porto HSR is illustrated in Figure 5-8.

Lisbon and Porto have already been connected by well-developed conventional rails and intercity roads nowadays. The journey time between these two cities is 2 hours 34 min on conventional rail, and 3 hours 24 min by intercity roads. (RAVE, 2008)

Figure 5-8 The Lisbon-Porto HSR in Portugal

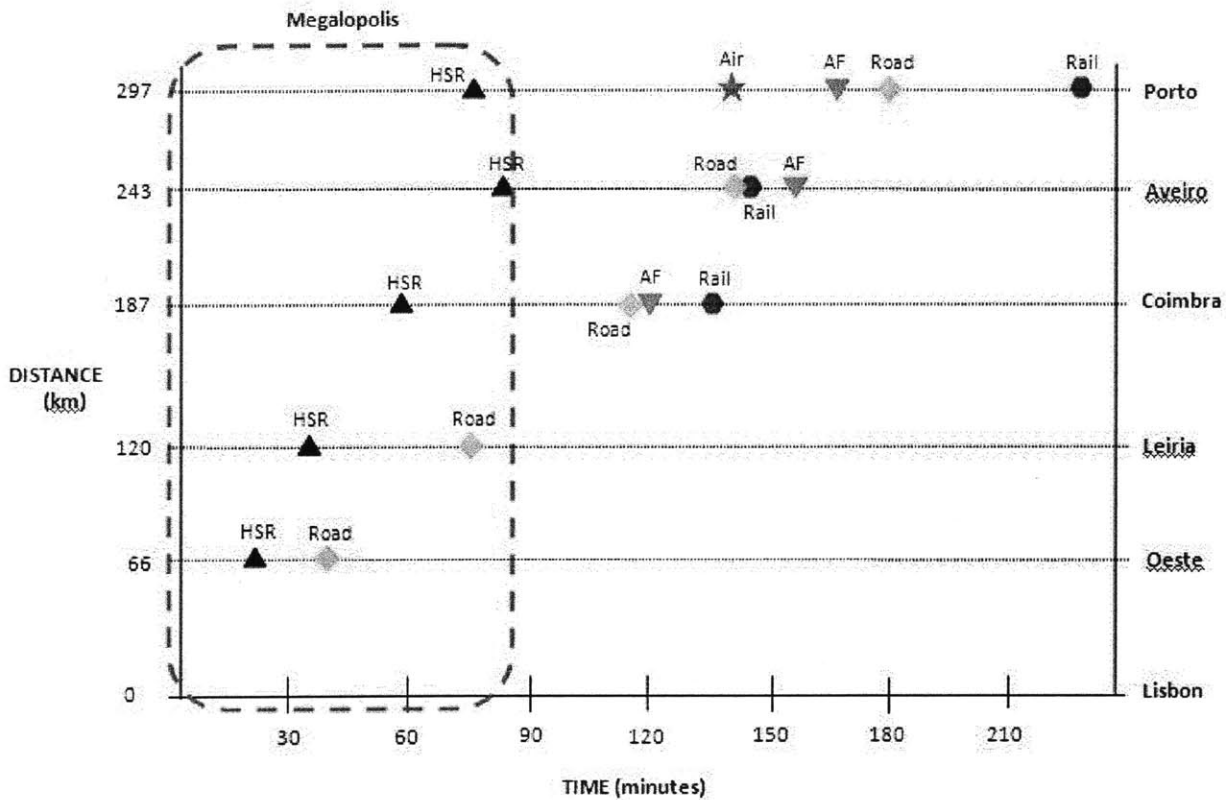


Source: RAVE.2008. The Portuguese High-Speed Rail Project: General Overview and Status of the Project. RAVE's presentation. Lisbon, Portugal. September, 2009.

According to Melibaeva, Sussman, and Dunn (2010), as illustrated in Figure 5-9, allowing the Lisbon-Porto corridor to become “a zone of one-day activity”, the Lisbon-Porto HSR may contribute to the formation of megaregions. There are four possibilities for the formation of megaregions: firstly, the

megaregions may be formed “between two main end cities (Lisbon- Porto)””; secondly, these megaregions may be formed “at one of either ends of the HSR routes or both simultaneously (Lisbon-Oeste- Leiria and Porto-Aveiro-Coimbra)””; thirdly, hybrid megaregions may be formed by combining the cases one and two mentioned above; The last possibility is that no megaregions will be formed because the Lisbon- Porto corridor has already had well-developed conventional rail services, with the incremental time-saving benefits of building HSR being small. (Melibaeva, Sussman, and Dunn, 2010)

Figure 5-9 Time Space Chart from/to Lisbon by Mode



Source: Melibaeva, Sussman, and Dunn, 2010

5.4. HSR's Economic Influence on Megaregions

5.4.1. Overview of HSR's Economic Influence on Megaregions

According to the analysis in the section *HSR and Megaregion Formation*, by decreasing the temporal distance and increasing the accessibility between cities, HSR contributes to the formation of megaregions. And the formation of megaregions will integrate both the labor and consumer markets, provide opportunities for larger agglomeration of economic activities, and raise the concerns for unbalanced growth with the megaregions.

According to Pol (2003), HSR “may affect the regional economy in two ways: it may act as a catalyst or it may have a facilitating effect.” The catalyst effect typically happens in the cities or regions with low economic growth, or at a phase of economic transition. These cities or regions “need a strong impulse to direct the local economy” and the connection to HSR network provides this necessary impulse. “In particular, actors in these cities are expected to carry out additional investments in response to the HST-connection in order to improve their economic potential.” Good examples of cities with the catalyst effect are Montabaur and Limburg in the Frankfurt- Köln megaregions.

The facilitating effect typically happens in the cities or regions with “a relatively high economic potential, and frequently the first to be connected to the HST-network”. These cities or regions “need to ensure that their accessibility keeps pace with their economic growth” and the connection to HSR network provides this necessary accessibility. These cities or regions are also expected to have additional investments in response to the connection to HSR networks. But Pol (2003) thinks these cities should focus more on the social equity issue. (Pol, 2003) A good example of cities with the facilitating effect is Paris and Lyon in the Paris-Lyon megaregions.

According to Pol (2003), the megaregion developments in response to the connection to HSR networks are supposed to focus on specific development areas. Schütz (1998) classifies these development areas into “primary, secondary and tertiary development zones” based on their accessibility to and from HSR stations. The details of these development zones are illustrated in Table 5-1.

Table 5-1 Development Zones in Response to the Connection to HSR Networks

	Primary development zone	Secondary development zone	Tertiary development zone
Accessibility to and from the HST-station	Direct, 5-10 minutes, on foot or by a transport mode	Indirect, <15 minutes, via complementary transport modes (incl. travel and change time)	Indirect, >15 minutes, via complementary transport modes (incl. travel and change time)
Location potential	Location for high-grade (inter)national functions	Secondary location for high-grade functions. Specialized functions related to specific location (cluster)	Variety of functions depending on specific location factors
Building density	Very high	High	Depending on specific situation
Development dynamism	Very high	High	Modest

Source: Schütz (1998)

According to Schütz (1998), in the primary development zone, “high-grade office and residential functions can be established and where relatively high increases in land and real estate values are expected.” In the second development zone, the increase in population density and real estate values will be much lower than that in the primary zone. The tertiary development zone is not able to show any direct development effect due to the connection to the HSR network, although it can benefit a bit from better accessibility.

As for the development effect of HSR on the whole region, HSR can promote the regional economic development, especially in certain industries, based on the case studies of Japan, France, and Germany, conducted by Sands (1993).

5.4.2. The Japanese Shinkansen’s Economic Influence on Megaregions

The Shinkansen significantly promote the economic development in megaregions: “Regions served by the Shinkansen generally have higher population and employment growth rates than those without direct Shinkansen service.” (Sands, 1993) According to Amano and Nakagawa (1990), the average annual growth rates of employments are 1.8 percent and 1.3 percent in cities with Shinkansen stations and their neighboring cities without Shinkansen stations. (Sands, 1993)

The promotion effect is more significant in some industries, such as “information exchange industries”: according to Sands (1993), the employment growth rates of information exchange industries are 22% and

7% in cities with both Shinkansen and expressway and cities with expressway only. The details of the employment growth of information exchange industries are illustrated in Table 5-2.

Table 5-2 The Employment Growth Rates of Information Exchange Industries (1981-1985)

	Shinkansen & Expressway (%)	Expressway Only (%)
Business Service (total)	42	12
Information, Investigation, Advertising Services	125	63
R&D and Higher Education	27	21
Political Institutes	20	11
Other	57	28
Banking Services	27	28
Real Estate Agencies	21	3
Total	22	7

Source: Sands (1993)

In addition, this promotion effect is also very significant in hotel and food sectors. According to Hirota (1984), the food and hotel sectors along the Sanyo Shinkansen had also experienced high growth in the 1970s: in Hakata, the terminal of the Sanyo line, the total number of hotels and rooms increased from 20 and 2,060 in 1972 to 40 and 5,320 in 1974 respectively, the year before the Sanyo Line reached there. In Okayama, midway on the Sanyo line, the total number of hotel guests grew from 170,000 in 1971 to 236,000 in 1975, the year when the Sanyo line reached there.

Furthermore, according to Sands (1993), Nakaraura and Ueda (1989) found that land value of the commercial areas grew 67 percent after the connection to the Shinkansen network. However, this argument was doubted and considered too large by Sands.

5.4.3. The French TGV's Economic Influence on Megaregions

The analysis in the section *HSR and Megaregion Formation* shows that: the French TGV contributes significantly to the increase of the total business travel on the Paris-Lyon corridor, especially those made for sale/purchase of services. (Melibaeva, Sussman, and Dunn, 2010) However, the benefits of economic development due to the building of the Paris-Lyon TGV are not distributed equally between Paris and Lyon: Paris has attained most of the economic development benefits because of the spatial concentration of population there. Lyon also gains some economic benefits, mainly “in the form of an increase in economic cooperation and exchanges with Paris”.

According to Sands (1993), three year after the launch of the TGV Atlantic (Paris-Le Mans), real estate values and transactions in several communities with stations had experienced significant growth. In Nantes, the connection to the TGV network “has spurred a major redevelopment project near the station as well as helped to produce a 20 percent rent premium on space in the redevelopment area.” (Sands, 1993)

5.4.4. The German ICE’s Economic Influence on Megaregions

One year since the building of the Hanover-Würzburg ICE and the Kassei-Wilhelmshöhe station, the business of office, retail, and hotel sectors around the Kassei-Wilhelmshöhe station had experience significant growth, with the rent for retail space increasing by 20 percent. In addition, a large part of land bordering the station was developed to “serve information/service sector firms requiring access to the ICE”.

5.4.5. Conclusion of HSR’s Economic Influence on Megaregions

HSR’s economic impact is most significant on the adjacent area of the HSR station, especially in the primary development zone, defined as areas that can be accessed within 5 or 10 minutes on foot or by a transport mode. (Schütz, 1998) on this area, we expect the increase of real estate and land values, and the prosperity of service industry, such as “information exchange industries”, retail and hotel industries. The “information exchange industries” include information, investigation, advertising services; R&D and higher education; political institutes; banking services; and real estate business.

It is hard to find literature modeling and quantifying the comprehensive regional impacts of HSR. Although only Sands (1993)’s study provides quantitative evidence that regions served by the Shinkansen generally have experienced higher population and employment growth rates than those without direct Shinkansen service, we do believe that HSR can influence the regional economic beyond the adjacent area of HSR stations and further research can explicitly illustrate this effect.

5.5. Megaregion revenues and HSR financing

5.5.1. Introduction to Megaregion Revenues and HSR Financing

Although HSR can bring positive economic impacts on megaregions, especially on the adjacent area of the HSR station, it is really expensive to build HSR. Based on the analysis in Chapter 1, *Introduction*,

HSR is more capital intensive than other transportation projects in both unit cost (the cost per lane km) and total cost. The average unit cost of HSR is about almost twice as much as the average unit cost of toll roads, and the total construction costs of HSR projects usually exceed 1 billion Euros, or 1.5 billion Euros, primarily due to the long distance nature of HSR projects.

According to the principle of “beneficiary pays”, it is justifiable to capture the additional, or at least part of the additional economic benefits of HSR development in megaregions, and use them to finance HSR development. We will focus on mechanisms that capture value generated by the direct economic impacts of HSR development since these direct impacts have been well understood and accepted. We will also briefly discuss mechanisms that capture value generated by the indirect economic impacts of HSR development if these indirect impacts are clearly determined.

Actually, public transportation investments can significantly increase the land and real estate value near public transportation stations just as HSR do. The potential mechanism used for capturing the value generated by the direct economic impacts of HSR development is called value capture. This value capture mechanism has already been widely used to finance public transportation in the world. For example, Versement Transport, one kind of value capture mechanisms, covered approximately 40% of the total transportation expenditure in France in 2000. We will discuss more detailed examples in each individual value capture mechanisms later.

5.5.2. Value Capture Mechanisms Based on HSR’s Direct Economic Influence

Value capture, as one type of public financing methods, captures the increase of private land or property values generated by a new public investment typically through special taxes or fees, and use the revenue to pay for that public investment or other public projects. The rationale for value capture is that increments in land or property values are wholly or partly attributed to public investments, such as HSR and public transportation investments, instead of private investments. It is justifiable to use taxes, fees, or other fiscal methods to indirectly to capture these value increments and use them to finance the public investments.

The value capture mechanisms based on HSR’s direct economic influences can be divided into four groups: property related charges (including land charges), land development charges, employer charges, and direct developments. Tax increment financing, business improvement districts (BID), business rate levy, and land value tax are all property related charges; Development impact tax is a land development

charge; Versement Transport is an employer charge; Land lease, and direct development are both direct developments. In addition, if further research can model and quantify the comprehensive regional impacts of HSR, we can further use part of consumption taxes and income taxes to finance the HSR investments. We will discuss these mechanisms in more detail in Section 5.5.11.

5.5.3. Tax Increment Financing

Tax increment financing, or TIF, earmarks the increase in property tax revenues in certain districts, named TIF districts, resulting from a public investment, and use this revenue to finance that public investment or other public projects. Tax increment financing is a property related charge and can be used to cover both the capital costs and operation costs of public investments, e.g., HSR investments. (Martínez, 2010)

Requiring no primary legislation, the tax increment in TIF is the increase of previous property tax revenue, which can be calculated by multiplying the incremental property value with old tax rate. The incremental property value is the difference between the property value after public investments, e.g. HSR building, and the property value at a base year. (Martínez, 2010)

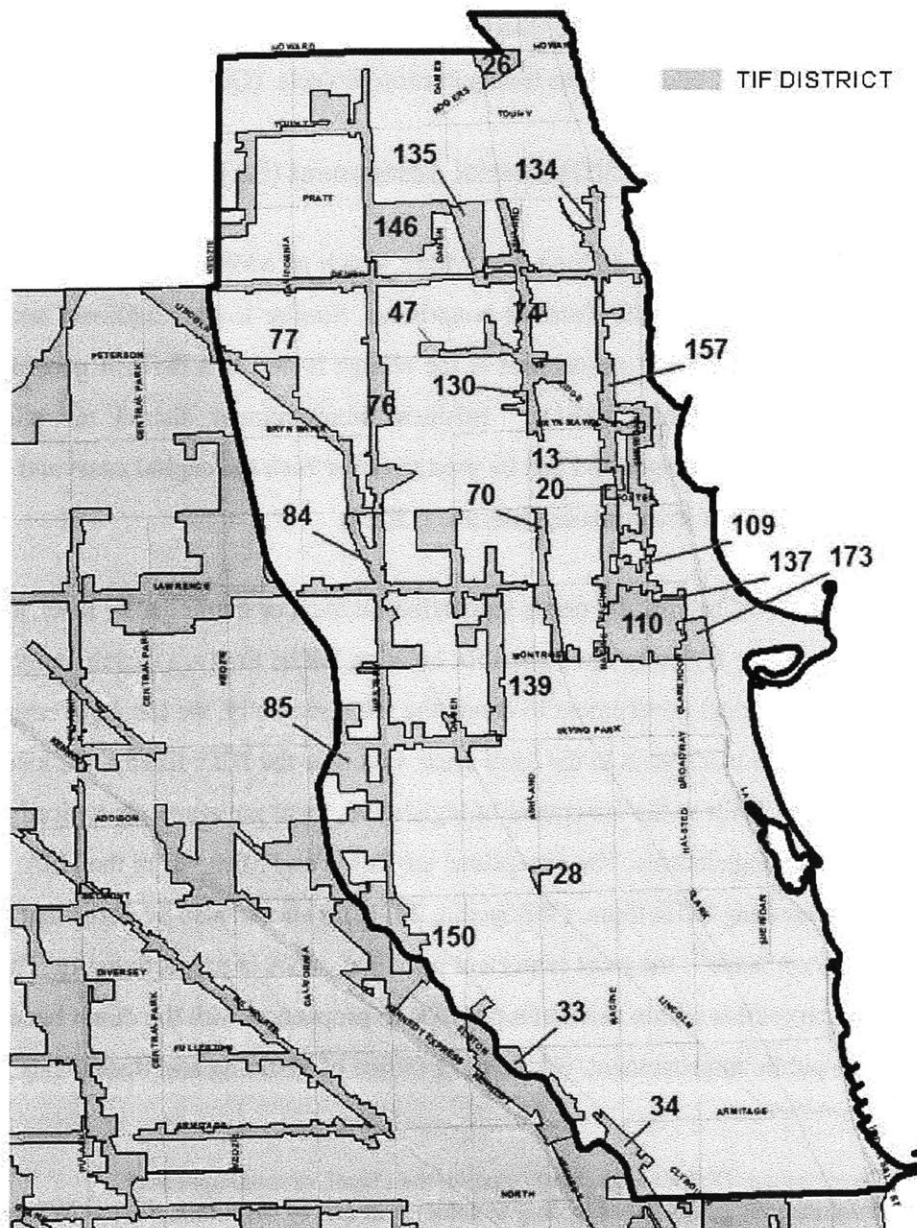
Therefore, the advantage of TIF is that there is no need to increase the current property tax rate or introduce new tax. Effectively capturing the HSR's economic benefits—the increase of land and real estate value around HSR stations, this tax is a reasonable way for the Portuguese HSR financing. These taxes can be levied to finance Portuguese HSRs no matter whether new HSR stations are built. However, at the same time, since the TIF is based on the incremental property value in the TIF district, the taxable value, or the value of tax base is low and unstable, and there is no guarantee for the financial stability³⁵ for this policy.

TIF has been widely used in the United States. For example, California, which introduced tax increment financing in 1952, has more than four hundred TIF districts now with aggregate revenue of over \$10 billion per year. (Chiang, 2009) The city of Chicago, in Cook County, Illinois, “runs 131 districts (approximately 30% of the Chicago city area) with tax receipts totaling upwards of \$500 million for 2006”. The map of north side TIF districts is illustrated in Figure 5-10. (Cook County Clerk's Office. 2007) Currently, the largest TIF project in the USA is the Mesa del Sol development project in

³⁵ Financial stability here is referred as the ability of the policy to generate stable and enough revenue for HSR development.

Albuquerque, New Mexico, worth 500 million USD. “The proposed development (of the Mesa del Sol project) would be built upon a ‘green field’ that presently generates little tax revenue and any increase in tax revenue would be diverted into a tax increment financing fund.” (Wikipedia, 2011b) This project is highly controversial because some people argue that the increase in tax revenue is not only due to the building of the Mesa del Sol project and too much money is diverted into the tax increment financing fund.

Figure 5-10 TIF in the North Side of the Chicago City



Source: City of Chicago. 2011. North Side TIF District Map. Retrieved March, 2011 from http://www.cityofchicago.org/city/en/depts/dcd/supp_info/tif/north_side_tif_districtmap.html

In addition, according to Transport for London (2003), through a scheme similar to TIF, local authorities of London have gathered more than 10 billion USD over the past five years.

TIF mainly faces two criticisms: the first one is that TIF districts may not actually serve their resident populations; the second one is that the increase in real estate value may be due to factors other than the direct public investments financed by the TIF, such as the inflationary increase, increase of public service and so on. According to Quigley (2007), the TIF districts would still attain about 40% of the increased value of properties even without the building of the transportation projects. (Quigley, 2007)

5.5.4. Business Improvement District (BID)/Special Assessment (SA)

Business improvement districts (BID)³⁶ is a defined area within which an additional tax or fee is raised to fund public infrastructure projects within the district's boundaries. Similar to the additional tax or fee in the Business improvement district, Special assessment is the charge levied in a defined geographic area known as a Special Assessment District (SAD). Business improvement district tax and special assessment are both property related charges and can be used to cover both the capital costs and operation costs of public investments, e.g., HSR investments. (Martínez, 2010)

The establishment of BIDs and SADs typically needs legislation on local or municipality level, although sometimes on state level. There are typically three steps for creating BIDs: firstly, a certain number of businesses should propose to the local government to create the BID; secondly, the local government should make sure that most of the businesses in the local areas welcome the BID; finally, the local government legislates for BIDs. Prior to the enactment of legislation, local governments typically need to seek authority grants from state legislatures. The exceptions are Texas and Missouri in the USA: state legislations are required for creating BIDs there. (Wikipedia, 2011c) It should also be noted that special assessments are not *ad valorem* taxes³⁷: the most important principal of SA is proportionality. The tax burden is spread across all properties within the SADs or BIDs in proportion with the direct benefit the property received from the public improvement. (Governor's Office of Planning and Research (California),

³⁶ The scale of Business Development District is generally smaller than local, or municipal scale.

³⁷ The definition of the ad valorem tax (Latin for according to value) is in *List of Definition*. Source: Wikipedia. 2011. Special assessment tax. Retrieved March, 2011 from http://en.wikipedia.org/wiki/Special_assessment_tax

1997) Therefore, the vacant land or property in the SIDs and BIDs will be taxed the same with those well developed land or property in the same spot, providing incentives for further development in the SADs and BIDs.

Compared with tax increment financing, the proportionality characteristic of business improvement district taxes and special assessments makes them more equitable considering the principal of “beneficiary pays”. In addition, the tax base for business improvement district tax and special assessment is the “benefit”. This benefit typically means “a particular and distinct benefit over and above general benefits conferred on real property located in the district or the public at large.” The “benefit” of a vacant land is the same as the “benefit” of those well developed land or property in the same spot, although the increase in market value of this vacant land may be less than the “benefit”. (Governor's Office of Planning and Research (California), 1997).

Effectively capturing the HSR's economic benefits of the land and real estate value increase around HSR stations, these business improvement district taxes and special assessments are reasonable methods for Portuguese HSR financing. These taxes can be levied to finance the Portuguese HSR projects whatever new HSR stations are built. However, similar to tax increment financing, these taxes have a narrow tax base and can only generate limited amount of revenue. When these taxes are used to fund public transportation projects, they can generate from 9% to 50% of the capital costs of the projects. (Martínez, 2010)

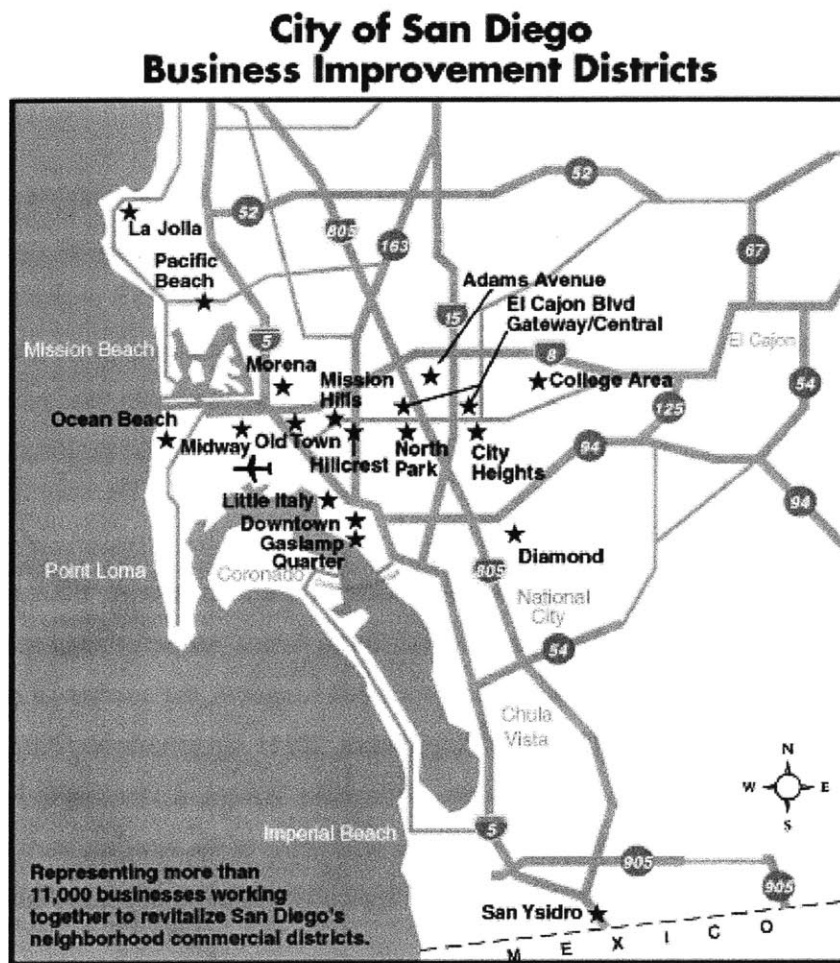
Currently, BID taxes and special assessments have all been widely used in the world: BIDs have been established in the United Kingdom, Germany, New Zealand, South Africa, and so on; and special assessment is also very popular in the United States. In the United Kingdom, the concept of BIDs was introduced by The Local Government Act 2003. (UK Legislation, 2011) Up to October 2007, there were 36 proposed or operational BIDs across Greater London. (Wikipedia, 2011c). According to British BIDs (2011), “the average size of a BID is 300-400 hereditaments, with some of the smallest having fewer than 50 hereditaments and the largest at 2,500. Annual income is typically £200,000-£600,000 but can be less than £50,000 per annum or over £2 million.”

In San Diego in the United States, the BID program was introduced back to 1970 with the creation of the Downtown Improvement Area, California's first metropolitan downtown district. Since then, eighteen separate business improvement districts have been created and more than 11,000 businesses are included

in these districts, generating more than \$1 million revenue annually. (The City of San Diego, 2011) The map of the business improvement districts in San Diego is illustrated in Figure 5-11.

In Los Angeles in the United States, special assessments are levied by the Southern California Rapid Transit District, now the Los Angeles Metropolitan Transportation Authority, to fund the building of new transit system. The special assessment district for a new rail line is typically within 400 to 800 m of the rail stations. (Doherty, 2004)

Figure 5-11 Business Improvement District in San Diego



Source: The City of San Diego. 2011. Business Improvement Districts. Retrieved March, 2011 from <http://www.sandiego.gov/economic-development/business-assistance/small-business/bids.shtml>

5.5.5. Business Rate Levy

According to Martínez (2010), business rate levy is similar to the business improvement district tax and special assessment. The only two differences between them are: firstly business rate levy is tax on local level instead of the level of business improvement district; secondly this business rate levy focuses more on non-residential properties. According to Martínez (2010), this business rate levy has been used to help finance London Crossrail.

This business rate levy can effectively capture the Portuguese HSR's economic benefits of the increase of land and real estate value around HSR stations. Since this tax has wider tax base than tax increment financing and special assessment, it has better financial stability. However, at the same time, since this tax is levied on local level instead of just near HSR station, this tax may capture more than reasonable benefits.

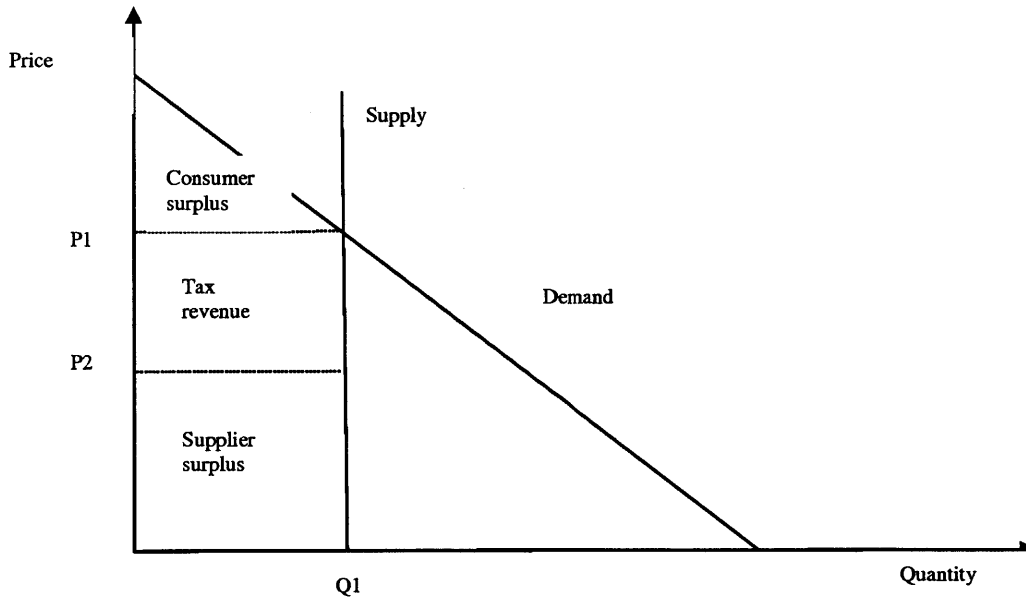
5.5.6. Land Value Tax

Land value tax (or site valuation tax) is “a levy on the unimproved value of land. It is an ad valorem tax on land that disregards the value of buildings, personal property and other improvements.” (Wikipedia, 2011d) According to Lari, Levinson et al (2009), this land value tax is the most general type of value capture policy in the world used for the provision for general public goods, including transportation networks. (Lari, Levinson et al, 2009) Moreover, this land value tax can be levied in different jurisdictions but is generally levied on the state level instead of the local level. For example, this tax is levied in almost all states in Australia as state taxes, and is also levied in the state of Pennsylvania in the US.

The land value tax is different from other property taxes because its tax base is only the land value while the tax bases of others are the whole property value, including lands, buildings and improvement of the sites. (Wikipedia, 2011d) However, a pure land value tax based only on the unimproved value of land is seldom seen in practice. Instead, some countries around the world, such as Canada, Australia, and so on, have implemented a split-rate system, with land and buildings taxed in different rates. (Martínez, 2010)

In theory, one advantage of land value tax is that it only transforms supplier surplus into tax revenue and does not create deadweight loss the way other property taxes do because the completely inelasticity of land supply. This can be further illustrated by Figure 5-12:

Figure 5-12 Theory of Land Value Tax



Source: sketched by the author

As illustrated in Figure 5-12, before the tax is levied, the equilibrium price is P_1 and the equilibrium quantity is Q_1 ; after the tax is levied (no matter whom are levied, consumers or suppliers), the effective price for suppliers changes to P_2 , the effective price for consumers remains P_1 , and the equilibrium quantity is still Q_1 . Since the equilibrium quantity does not decrease, no deadweight loss is created. The impact of tax here is just to transform part of the supplier surplus into tax revenues.

According to Lari, Levinson et al (2009), the land value tax provides incentives for the land owners to improve their property and is an efficient way to prevent urban sprawl because the tax rate on land is typically much higher than that on buildings. For example, the tax rate on land is five times larger than that on improvements in Harrisburg, Pennsylvania in the United States. This land value tax policy has reduced the number of vacant buildings in downtown Harrisburg from approximately 4,200 in 1982 to fewer than 500 now. (Wikipedia, 2011d)

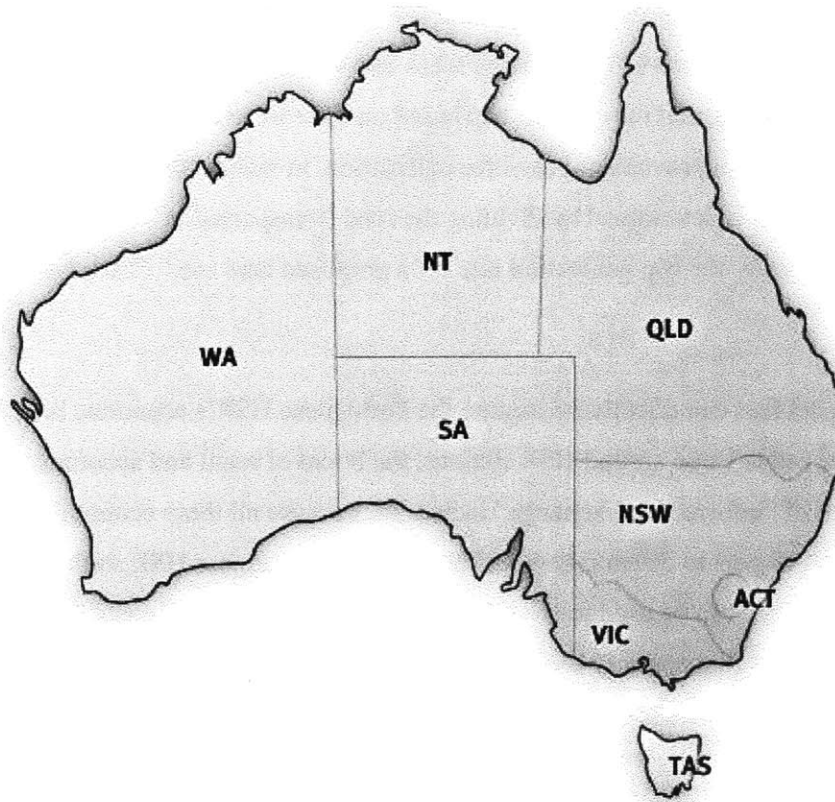
This land value tax can also effectively capture the Portuguese HSR's economic benefits of the increase of the land and real estate value around HSR stations, and it can be used to recover both capital and operation costs. Actually, this land value tax captures the change of real estate value from many sources beside a specific transportation project, and therefore it reduces the need for further value capture. (Lari,

Levinson et al, 2009) In addition, since this tax has wider tax base than tax increment financing and special assessment, it has better financial stability.

However, at the same time, since this tax is levied on state level instead of just near HSR station, it is unfair to use all the tax revenue to finance Portuguese HSR only. Moreover, if Portugal does not have this land value tax now, a primary legislation is needed for the application of this land value tax to finance Portuguese HSR projects. And the levy of this land value tax may require regular valuation.

Australia is a good example of countries applying this land value tax policy. According to Defense Housing Australia (2011), “land tax is imposed in all states and territories, except the Northern Territory.” The map of Australia is illustrated in Figure 5-13.

Figure 5-13 Map of Australia



Source: Defense Housing Australia. 2011. Land tax. Retrieved March, 2011 from <http://www.invest.dha.gov.au/dha/home/info/landtax.sok>

The state of New South Wales in Australia levies a state land value tax. However this state land value tax is only levied on “value over a certain threshold” with “farmland and a person's principal place of residence” get exemption. In addition, revenue from property taxes represents 4.5% of total taxation in Australia. (Wikipedia, 2011d)

5.5.7. Development Impact Tax

According to Lari, Levinson et al (2009), development impact fees are “one-time charges collected by local governments from developers for the purpose of financing new infrastructure and services associated with new development.” Therefore, from the definition, we can see these fees are levied on local level.

According to Lari, Levinson et al (2009), development impact taxes can be calculated using two methods. The first one is the demand-driven fee calculation, which is based on the estimated demand impact of new developments on transportation network. This method takes into account “the number of new trips generated, the average trip length, and the cost per trip based on the cost to improve the transportation system.” The second one is the improvement-based fee calculation, in which “the average cost of the trips generated by the development is determined by dividing the road (transportation system) improvements budget of a local jurisdiction by the trip generation rate for a proposed land use.” (Lari, Levinson et al, 2009)

These development impact fees can effectively capture the Portuguese HSR’s economic benefits of the increase of land and real estate value around HSR stations, the boom of retail and accommodation industries, and the boom of “information exchange” industries, because all these economic benefits provide incentives for developers to develop new real estates near Portuguese HSR stations. In addition, these development impact fees can be used to recover both capital and operation costs. (Martínez, 2010) Since the development impact fees are only levied on new developments, they can only be used to finance Portuguese HSRs when new HSR stations are built.

These development impact fees are typically only levied on new developments so they are greatly exposed to the demand risks of new commercial and housing spaces: the revenues are highly volatile and unstable. Therefore, to use these fees as a source of Portuguese HSR financing, we need strong and convincing evidences that HSR can actually generate strong economic benefits in megaregions, especially

on the adjacent area of HSR stations. Otherwise, these development impact fees will not have financial stability.

According to Lari, Levinson et al (2009), these impact fees are widely used in the US, especially in fast growing areas such as California, Florida, and Texas. According to Altshuler, Gomez-Ibanez et al. (1993), the percentage of jurisdictions using this type of tax mechanism had increased from less than 10% prior to 1960 to about 60% by the mid-1980s in the US.

5.5.8. Employer Tax (Versement Transport)

According to Martínez (2010), employer taxes are “taxes charging the productivity enhancements derived from increased accessibility, and allowing each firm to have larger catchment’s areas of qualified employees.” The most successful example of employer taxes in the EU or even in the world is the Versement Transport in France: this tax covered approximately 40% of the total transportation expenditure in France in 2000. (Hass-Klau, 2006)

This Versement Transport was originally introduced in the Ile-de-France³⁸ in 1971, and “extended to local authorities or large organizations (transport regions) that provide public transport for more than 300,000 inhabitants in 1973.” (Martínez, 2010) Since 2000, the year the restriction was further relaxed, local authorities or large organizations with more than 10,000 inhabitants are entitled to levy this tax and use the revenue to finance public transport development. (Hass-Klau, 2006)

According to French laws, both public and private employers hiring more than nine employees and locating within a region managed by transport authorities may be asked to pay from 0.55% to 2.2% of its total payroll as the Versement Transport. As for Ile-de-France, the tax rates are 2.2%, 1.6%, and 1.3% in central areas, inner ring, and outer ring respectively; as for provincial cities with more than 100,000 inhabitants, the tax rates are 1.75% and 1.0% for areas with fixed track system and without fixed track system; as for provincial cities with less than 100,000 inhabitants, the tax rate is 0.55%. (Hass-Klau, 2006)

The Versement Transport contributed significantly to the building of metros in Lille, Lyon and Marseille. And this Versement Transport helped increase the public transport investments in France: public transport

³⁸ Île-de-France is the wealthiest and most populated of the twenty-six administrative regions of France, composed mostly of the Paris metropolitan area. It is one of France's administrative regions. Source: Wikipedia. 2011. Île-de-France (region). Retrieved March, 2011 from http://en.wikipedia.org/wiki/%C3%8Eile-de-France_%28region%29

investments increased from only one third of road investments to almost the same as road investments from 1970 to 1980, in the major cities of France. In Paris, the Versement Transport raised approximately 945 million Euros, and covered 20% of the RATP1 and SNCF2 operational budget in 1988. (Martínez, 2010)

According to the France's experience, this employer tax can provide significant amount of revenue with good financial stability. This employer tax can effectively capture the HSR's economic benefits of booming retail, accommodation, and "information exchange" industries around HSR stations, and it is a reasonable mechanism for the Portuguese HSR financing. This employer tax can be levied to finance the Portuguese HSR projects no matter whether new HSR stations are built, but it should generate more revenues when HSR stations are just the existing railway stations because businesses have already clustered near the existing railway stations. However, to use these taxes as a source of the Portuguese HSR financing, a primary legislation is required and public acceptance is a key issue here. Moreover, this employer tax may in some sense discourage the business developments around HSR stations if the tax rate is too high.

5.5.9. Land Lease

Land lease is "the most powerful tool used to intervene on the land and housing markets." In land leases, "the government possesses the right to own, and private developers lease from the government the right to develop, use, transfer, inherit, and benefit from land." In land leases, the government can determine the type of development rights it grants and the length of grants here. (Martínez, 2010)

The prerequisite for this land lease policy is that the government still owns the land. Otherwise, the government may have to repurchase the lands back from private owners before the public investments. In Portugal, since most developed lands are owned by Portuguese people, this financing mechanism seems only to be feasible for financing HSRs when new HSR stations are built.

The advantages of leasing land close to HSR stations includes: firstly it can effectively internalize the increase value of land and real estate due to the building of HSR; secondly it complies perfectly with the principal of "beneficiary pays", and in our definition, it is an equitable financing method for the whole society. However, similar to the development impact tax, this land lease policy is also significantly exposed to the demand risks of new commercial and housing spaces, making corresponding revenues volatile and unstable. To use the land lease as a source of Portuguese HSR financing, we need strong and

convincing evidence that Portuguese HSR can actually generate strong economic benefits near HSR station.

One appropriate example for the application of this land lease policy is Hong Kong. Hong Kong use a “Rail+Property” approach to finance its public transportation system: the government leases lands and provides long-term land development rights to MTR, the transit agency in Hong Kong; and in return, the government only needs to pay part of the construction costs. (The Transport Politic, 2010)

For the South Island metro Line project in Hong Kong, the Hong Kong government approves MTR land development rights to a site located at the former Wong Chuk Hang estate. In return, the transit agency only requires the government to contribute less than half of the construction costs. Up to now, along the urban rail lines, the MTR has funded dozens of new housing projects with 300 to 7,000 apartments each. (The Transport Politic, 2010) On the other hand, we should also notice that Hong Kong is a very dense city with more than 90% of journeys made by public transportation when we see the success of land lease in Hong Kong.

5.5.10. Direct Development

This direct development policy is similar to the land lease policy. The only difference is that in this direct development, lands of HSR stations and some areas close to HSR stations, associated with their development rights, are given directly to HSR developers. If PPP is used as the procurement method, these HSR developers are the private sector in PPP. In the Portugal case, because PPP is highly likely to be used in the Portuguese HSR projects in the future, these land ownerships and direct development rights can be added to the bidding package in the bidding process. The direct development policy provides incentives for the private sector to develop better HSR lines, and provide better HSR services, because better HSR services can help boost businesses in HSR stations and areas close to HSR stations. In return, prosperous businesses in HSR stations and areas close to HSR stations can help increase the attractiveness of HSR compared to other transportation modes, further increasing HSR fare revenues.

Similar to the land lease policy, the prerequisite for this direct development is also that the government still owns the lands. In Portugal, since most of developed lands are owned by Portuguese people, this financing mechanism is only feasible when new HSR stations are built.

Similar to land lease, the advantages of the direct development includes: firstly, it can effectively internalize economic benefits of Portuguese HSR building, such as the increase value of land and real estate, prosperity of retail, accommodation, and information exchange industries; secondly, it provide incentives for the private sector in PPP to better develop HSR lines, HSR stations and lands close to HSR stations; thirdly it complies perfectly with the principal of “beneficiary pays”, or the social equity principal. However, this direct development policy is also greatly exposed to the demand risks of new commercial and housing spaces, making the corresponding revenues volatile. In PPP, these demand risks are born by the private sector. The success of this direct development financing method depends significantly on the direct economic benefits that Portuguese HSR can actually generate near HSR stations. If the real economic benefits are too low to cover even the direct development costs (excluding the original cost of building HSR lines and HSR stations), the private sector will reject this financing mechanism.

The most appropriate example that can be used to illustrate this direct development policy is Japan. The East Japan Railway Company (JR East) was given the rights to developed space in some HSR stations and some properties close to HSR stations after the privatization of the Japanese National Railways (JNR). JR East’s non-transportation income ³⁹consists of income from station space utilization, shopping centers, office buildings, and other services (including transportation advertising businesses, hotel businesses, etc.). Details of the components of JR East’s operating revenue are illustrated in Table 5-3

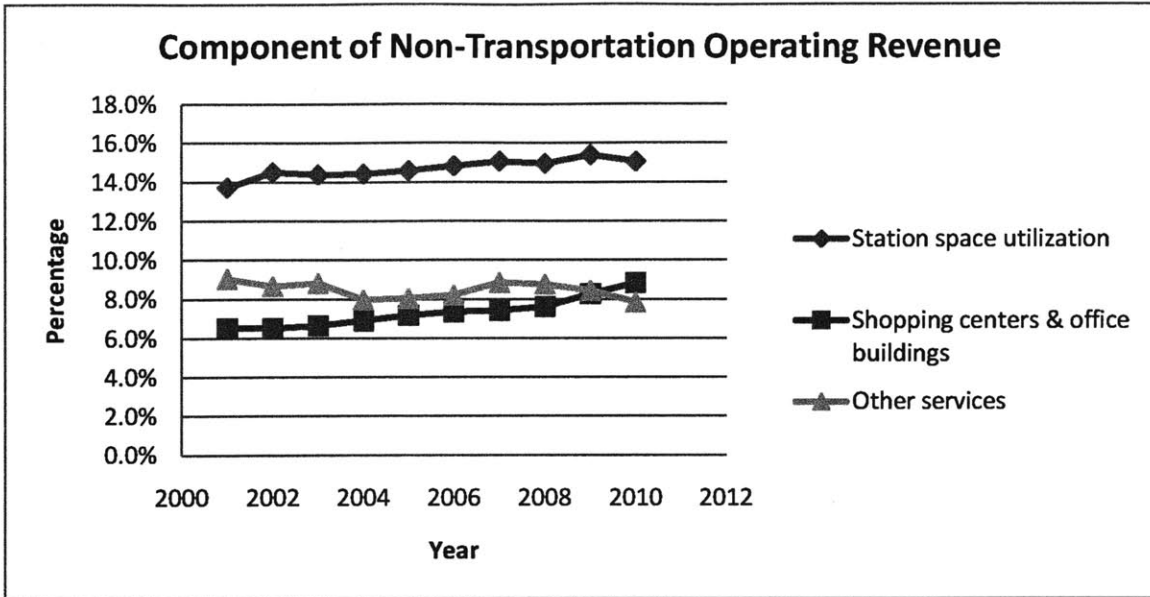
Table 5-3 Components of JR East's Operating Revenue

Operating revenue	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Transportation	70.8%	70.4%	70.2%	70.7%	70.2%	69.6%	68.7%	68.7%	67.9%	68.3%
Station space utilization	13.7%	14.5%	14.4%	14.4%	14.6%	14.8%	15.1%	14.9%	15.4%	15.0%
Shopping centers & office buildings	6.5%	6.5%	6.6%	6.9%	7.2%	7.3%	7.4%	7.6%	8.3%	8.8%
Other services	9.0%	8.6%	8.8%	8.0%	8.0%	8.2%	8.8%	8.7%	8.4%	7.8%
Non-Transportation	29.2%	29.6%	29.8%	29.3%	29.8%	30.4%	31.3%	31.3%	32.1%	31.7%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: East Japan Railway Company. 2010. Annual Financial Report of 2010.

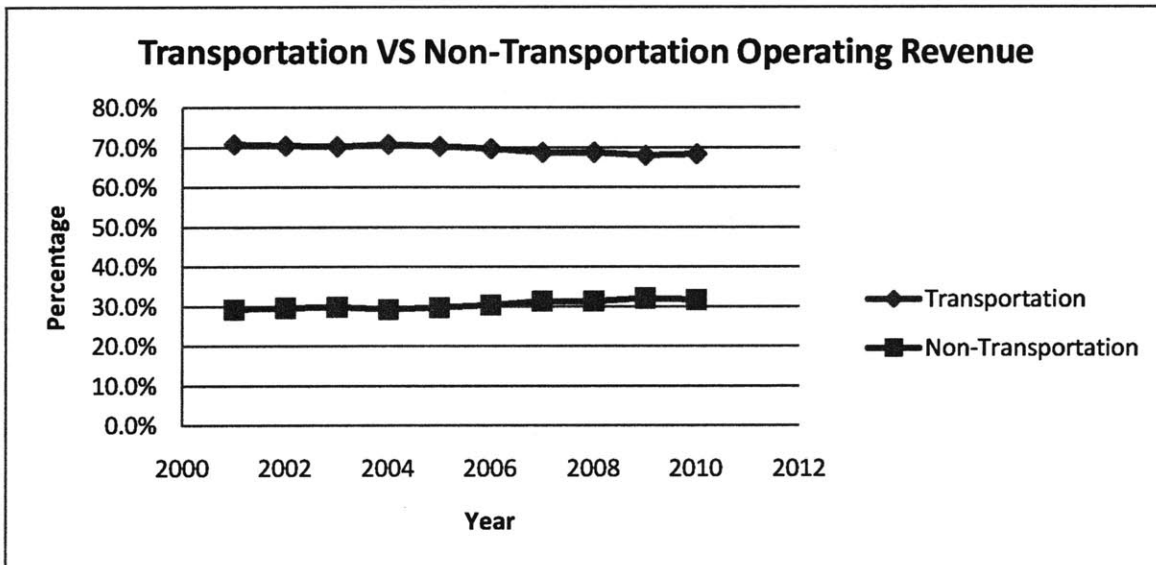
³⁹ Here transportation income means income generated from normal transportation activities, such as fare revenues. Non-transportation income means income generated from economic activities other than normal transportation activities.

Figure 5-14 Components of JR East's Non-Transportation Operating Revenue



Source: East Japan Railway Company. 2010. Annual Financial Report of 2010.

Figure 5-15 Transportation VS. Non-Transportation Operating Revenue



Source: East Japan Railway Company. 2010. Annual Financial Report of 2010.

From Table 5-3, Figure 5-14, and Figure 5-15, we can see this non-transportation revenue accounts for appropriately 30% of the total operating revenue for JR East every year, and it is an important revenue source for JR East. Within this non-transportation revenue, station space utilization revenue accounts for the largest part, about 15% of the total operating revenue. But shopping center & office building revenue

keeps increasing as a percentage of the total operating revenue in the past ten years, even during the 2008 financial crisis.

In railway stations, including HSR stations, JR East operates a wide variety of businesses, including retail outlets and restaurants that provide customers with convenient and comfortable services. The passenger volume is the key factor JR East considers when developing this station space. According to JR East (2010b), JR East is now considering the further development of non-transportation services since many railway stations it owns have high passenger volumes: “91 railway stations are used by more than 100,000 passengers a day, including 36 railway stations used by more than 200,000 passengers a day as of March 2010.”

JR East develops “ecute” commercial spaces⁴⁰ inside the railway station, including HSR stations. The business in these “ecute” commercial spaces includes: deli, confectionary, variety shops, eating and drinking establishments, services, etc. (JR East, 2004) Now JR East is in its “Station Renaissance Program” and is renewing aging commercial shopping areas in the stations in order to make them more attractive. (JR East, 2011b)

In addition, JR East develops shopping centers in the railway stations, and develops and leases office buildings in highly convenient locations that have direct access to its railway stations. By March, 2010, the number of shopping centers and office buildings operated by JR East had grown to 133 and 20 respectively. JR East believes the building of shopping centers can attract more people to use its transportation services, and the railway station can also help the business of shopping centers prosper. (JR East, 2011b)

Transportation advertising businesses, including those in both stations and trains, are another important source of revenue for JR East. To better deal with the revenue decline due to the 2008 financial crisis, JR East “intends to heighten the value of advertising media for advertisers through further digitization and network incorporation”, for example, J-AD Vision Exploits Large-Capacity Wireless Service. (JR East, 2011b) Hotel services are the last component of the non-transportation businesses in JR East. JR East

⁴⁰ “ecute” is a nickname JR East picks for New Spaces for Ticketed Passengers (“Ekinaka”). Source: <http://www.jreast.co.jp/e/press/20040501/index.html>

operates hotels in the metropolitan areas and near the terminal of major regional railway stations. (JR East, 2011b)

Therefore, we can conclude that the non-transportation businesses that JR East operates make full use of the direct economic impacts of HSR on megaregions: JR East's non-transportation businesses include station space utilization, shopping centers, office buildings, transportation advertising businesses, hotel businesses, etc.; whereas the direct economic impacts of HSR on megaregions includes increasing land and real estate value, and booming retail, accommodation, and "information exchange" industries around HSR stations.

The Japanese experience provides valuable lessons for Portugal in using this direct development method to finance its HSR building: the businesses developed in this direct development should be in line with the direct economic benefits generated by HSR building. The development of retail shops and hotels can capture the economic benefits of booming retail and accommodation industry. The development of office building can capture the economic benefits of increasing land and real estate value, and it can also capture the benefits of booming information, investigation, and banking service industries, part of "information exchange" industries, because businesses of these industries generally locate in office buildings. Therefore, retail shops, hotels, and office buildings should be the most appropriate businesses in direct development.

5.5.11. Consumption Tax/Income Tax

A consumption tax is "a tax on spending on goods and services. The tax base of such a tax is the money spent on consumption." The consumption taxes are usually indirect taxes⁴¹, but can also be direct taxes. For example, value added taxes and sale taxes are both indirect taxes; while expenditure tax is an indirect tax. (Wikipedia, 2011e) An income tax is a tax levied on the income of individuals or businesses (corporations or other legal entities)." (Wikipedia, 2011h)

However, the prerequisite for using consumption tax or income tax as a value capture means to finance Portuguese HSR buildings is the positive comprehensive regional impact of HSR building. Only if further research can model and quantify the comprehensive regional impacts of HSR, consumption taxes, or

⁴¹ The definition of direct tax and indirect tax is in *List of Definition*.

income taxes, or the increase of consumption taxes and income taxes can be used as appropriate value capture mechanisms for HSR financing.

If HSR is able to bring positive comprehensive economic benefits to megaregions that is not yet proved, these consumption tax and income tax are appropriate methods to capture these benefits because both consumption tax and income tax are directly related to the economic condition of megaregions: as the economy of megaregions becomes better, people will have higher income and usually consume more. In addition, these consumption tax and income tax should have good financial stability because of its wide tax base.

5.5.12. Portugal's Current Tax System Related to Value Capture

Currently, Portugal has some exactions and negotiated fees between municipalities and companies, in the case of which, companies are obliged to pay to build the infrastructure if they want to locate in a low accessible location. But Portugal doesn't have any other value capture mechanisms. (Martínez, personal communication, 2011)

In Portugal, the most relevant taxes related to value capture mechanisms mentioned above are annual property tax (Imposto Municipal Sobre Imóveis, IMI), and property purchase tax (Imposto Municipal, IMT). As for IMI, property owners are required to pay a certain amount of taxes to the government if they own the property. The tax is calculated as the product of IMI tax rate and real estate value. The IMI tax rate can vary from municipalities to municipalities, but within lower and upper bounds set by the national government of Portugal. (Santos, personal communication, 2011) The real estate value is calculated based on the average cost of construction; areas, location and type of building; the intrinsic characteristics of buildings; and the surrounding urban facilities and infrastructures. (Real estate value = $VC * A * CA * CL * QC * CV$, where CV = base value of the buildings built, A = total gross floor area plus the area over the area of deployment; CA = coefficient of allocation, CL = coefficient of location, QC = coefficient of quality and comfort, CV = coefficient of obsolescence). (SIGIMI, 2011)

In addition, property buyers are required to pay IMT. The IMT tax is calculated by the product of IMT tax rate and the sale price. Permanent residents and non-permanent residents are taxed differently here. The IMI tax rates are listed in Table 5-4, and Table 5-5 below:

Table 5-4 IMI Tax Rate for Permanent Residences

Permanent Residence	
Purchase Price (Euros)	Marginal tax rate
Up to €90 418	0
€90 418 - €123 682	2
€123 682 - €168 638	5
€168 638 - €281 030	7
€281 030 - €561 960	8
Over €561 960	Single flat rate of 6%

Source: ExpatsPortugal (2011)

Table 5-5 IMI Tax Rate for Non-Permanent Residences

Non-permanent Residence	
Purchase Price (Euros)	Margin tax rate
Up to €90 418	1
€90 418 - €123 682	2
€123 682 - €168 638	5
€168 638 - €281 030	7
€281 030 - €538 978	8
Over €538 978	Single flat rate of 6%

Source: ExpatsPortugal (2011)

In addition, people purchasing their main residences, not the second or holiday homes, are able to apply for IMI exemption: people are able to get 8 year IMI exemption when they purchase property worth less than 157,500 Euros; they are able to get from 6 to 7 year IMI exemption when they purchase property worth between 157,500 and 236,000 Euros.

The current property tax system in Portugal makes tax increment financing highly applicable, because there is no need for the change of tax rate and primary legislation. The Portuguese government just needs to dedicate this incremental tax revenue resulting from the building of HSR to finance the HSR building. Only small legislation changes are needed and no public acceptance issues will be incurred.

5.5.13. Value Capture for the Portuguese HSR Building

It is important to take a close look at characteristics of different value capturing methods before we provide suggestions for Portuguese HSR financing. These characteristics are summarized in Table 5-6 and Table 5-7.

Table 5-6 Characteristics of Different Value Capture Mechanisms (I)

Funding methods	Type	Target	Scale	Related economic benefits	Primary legislation
Tax Increment Financing	Property tax	Property in TIF district	TIF district	Increase of real estate price near HSR station	No
Business Development District/Special Assessment	Property tax	Property in BIDs and SADs	BIDs and SADs	Increase of real estate price near HSR station	No
Business rate levy	Property tax	Property	Local level	Increase of real estate price near HSR station	No
Land value tax	Property tax	Land	Mostly state level	Increase of real estate price near HSR station	Yes
Development impact tax	Development tax	New development	Local level	Increase of real estate and land value; Prosperity of retail, accommodation and information exchange industries near HSR stations	NA
Versement Transport	Employer tax	Employer	Region managed by transportation authority, e.g., HSR authority	Increase of real estate and land value; Prosperity of retail, accommodation and information exchange industries near HSR stations	Yes
Land lease	Direct development	New development	HSR stations and areas close to HSR stations	Increase of real estate and land value; Prosperity of retail, accommodation and information exchange industries near HSR stations	No
Direct development	Direct development	New development	HSR stations and areas close to HSR stations	Increase of real estate and land value; Prosperity of retail, accommodation and information exchange industries near HSR stations	No
Consumption tax/ income tax	Consumption tax/ income tax	Retail business	Nation wide	HSR's indirect economic influence on megaregions	Yes

Table 5-7 Characteristics of Different Value Capture Mechanisms (II)

Funding methods	Property type (if property tax)	Ad valorem tax (if property tax)	Current application	HSR station requirement	Financial Stability	Social Equity ⁴²	Feasibility ⁴³
Tax Increment Financing	All property	Yes	United States, United Kingdom, etc.	Both new and old	Medium/low	High	High
Business Development District/Special Assessment	All property	No	United States, United Kingdom, Germany, New Zealand, etc.	Both new and old	Medium	High	High/medium
Business rate levy	Mostly non-residential property	No	United Kingdom	Both new and old	Medium	Medium	Medium/low
Land value tax	Land only	Yes	Canada, Australia, United States, etc.	Both new and old	High	Medium/low	Low
Development impact tax	NA	NA	United States, etc.	Only new	Medium/low	Medium/low	High
Versement Transport	NA	NA	France	Both new and old, but prefer old	High	High	Low
Land lease	NA	NA	Hong Kong, etc.	Only new	Medium/low	High	High
Direct development	NA	NA	Japan, etc.	Only new	Medium/low	High	High
Consumption tax/ income tax	NA	NA	All the world	Both new and old	High	Medium/low	Medium/low

Source: summarized by the author

From Table 5-6 and Table 5-7, we can see no value capture mechanism is superior to the others in all aspects: some have good financial stability, but bad social equity, e.g. land value tax; some has good social equity, but bad financial stability, e.g. tax increment financing; some has good financial stability and good social equity, but requires primary legislation and may have huge public acceptance problems, e.g. Versement Transport. Different value capture mechanisms may be chosen when different evaluation criteria are used. The only global constraint is whether new HSR stations will be built: if new HSR stations will not be built, development impact tax, land lease and direct development will all be infeasible.

⁴² Here social equity is defined as benefit equity, which describes the allocation of benefits across people. In this definition, beneficiary pay is the fairest way for HSR financing.

⁴³ Feasibility evaluates value capture mechanisms based on their political and administrative feasibility.

5.6. Conclusion

Due to the high speed characteristic, HSR decreases the temporal distance, increases the accessibility between cities, and therefore may contribute to the formation of megaregions. HSR's economic impact is most significant on the adjacent area of HSR stations: the increase of real estate or land value, and the prosperity of service industry, such as "information exchange industries", retail and accommodation industries are expected to see on this area.

We can use value capture mechanisms to capture these economic benefits resulting from the building of the Portuguese HSR projects, and use these revenues to finance the Portuguese HSR building. After analyzing all related value capture mechanisms, we find no mechanism is superior to all others in all aspects and no perfect one can be found. The decision-making authorities should consider the trade-off between different criteria.

If we consider social equity ("beneficiary pays") as the most important criterion, tax increment financing, business development district/special assessment, Versement Transport, land lease, and direct development may be chosen assuming new HSR stations will be built. In addition, based on the analysis of Portugal's current tax system related to value capture, we can see tax increment financing is highly applicable because only small changes are needed and no public acceptance issues will be incurred. However, all tax increment financing, business development district/special assessment, land lease and direct development may not be able to generate enough revenue or may only generate volatile revenue. In other words, they don't have good financial stability. Versement Transport may meet the public acceptance problems when enacting primary legislation in spite of its good social equity and financial stability.

If we consider financial stability as the most important criteria, land value tax, Versement Transport, income tax and consumption tax may be chosen. However, levied mostly on state level, land value tax does not agree with our social equity ("beneficiary pays") criterion well, and may encounter public acceptance problems because it requires primary legislation; consumption tax or income tax is only justifiable when further research can prove the positive comprehensive economic impacts of HSR on megaregions, and it also has this social equity problems; Versement Transport require primary legislation and may be objected by the public.

6. Conclusion and Suggestions for HSR Financing in Portugal

Portugal's economy is in a very difficult period right now. Portugal's sovereign debt rating has been downgraded significantly recently. For example, on April 5th, 2011, Portugal's sovereign debt rating was further downgraded by Moody's Investors Service to Baa1, three steps from junk status. (Ross-Thomas and Meier, 2011) on April 6th, 2011, Portugal asked the European Union (EU) and International Monetary Fund (IMF) for financial bailout. And on May 3rd, 2011, the European Commission, the International Monetary Fund and the European Central Bank issued the Memorandum of Understanding on Specific Economic Policy Conditionality for Portugal to require Portugal to endure years of unprecedented austerity, government expenditure cut and taxes rise. Based on the analysis in Chapter 1, *Introduction*, requirements in the MOU make it open to question for Portugal to build new HSR lines in the near future.

Therefore we assume that Portugal will build other HSR lines only when the economy of Portugal has significantly recovered and when the bailout has been over. At that time, the conclusion of this thesis will come into play.

This thesis has examined the crowding out effect of HSR investments on other transportation projects, and compared HSR financing with the financing of other transportation projects. To make HSR investments more financially viable, this thesis has also identified innovative financing methods that can be used to lower the financial costs of HSR investments, and explored appropriate value capture mechanisms that can be used to capture the economic benefits of HSR on megaregions and finance the building of the Portuguese HSR projects.

6.1. Summary of Findings and Recommendations

This thesis begins by raising the concern that although HSR may increase capacity of transportation infrastructure, provide an environment friendly transportation alternative, and promote regional economic development, HSR is more capital intensive than other transportation projects and may crowd out the investments on other transportation projects.

Chapter 2 *Crowding Out Effect of HSR Investment* examines this crowding out effect and concludes that crowding out effect of HSR investments exists in the world: the building of HSR can make the funds of other transportation projects less available. The crowding out effect is generally significant in the countries in the initial stage of the formation of their HSR system, e.g. China; this effect is generally

insignificant in the countries with mature HSR system, e.g. Germany and Japan. We believe Portugal is also in the initial stage of the HSR system formation just as China does, and Portugal needs to pay attention to this crowding out effect when building new HSR projects in the future.

Chapter 3 *Difference between Financing HSR and Other Transportation Projects* compares HSR financing with the financing of other transportation projects in China, Germany, Taiwan, Portugal, and Japan. This chapter concludes that HSR projects are relatively harder to attract private capital for and rely more on the government's funding capabilities compared to road, airport, and seaport projects. The current Portuguese HSR financing mechanism relies heavily on EU funds and EIB loans, and this reliance makes the Portuguese HSR development more vulnerable to EU and EIB policy change. We need to explore more HSR funding opportunities for Portugal in the future. After studying the experience of China and Taiwan, we believe some unexplored opportunities may exist in bond capital markets.

Chapter 4 *Innovative Financing Methods* identifies innovative financing methods that can be used to lower the financial costs of HSR investments. This chapter concludes that wrapped bond financing is the most promising way to finance the Portuguese HSR projects in the future because of its low financial costs, long financing terms and so on. But this wrapped bond model has become significantly infected since the 2008 financial crisis because of the downgrade of monoline companies, and it is beneficial for the Portuguese government to establish a national debt guarantee program to help with the revival of the monoline wrapped bond model.

To support this national debt guarantee program, it is beneficial for the Portuguese government to establish a national infrastructure bank. The Portuguese infrastructure bank should provide loans or guarantees to infrastructure projects in line with public interests just as the EIB and the proposed Obama's Bank do, but it should focus more on the monoline guarantee business than the EIB and the proposed Obama's Bank do considering the fact that the wrapped bond financing is the most promising way to finance the Portuguese HSR projects in the future.

The Portuguese infrastructure bank should maintain a high rating like the EIB, e.g. Aaa, and be able to borrow at low financial costs in the global capital markets. If the Portuguese government can achieve a high rating, such as Aaa, in the future, this Portuguese infrastructure bank can benefit from receiving guarantees from the Portuguese government or becoming a subsidiary of the government. However, if the Portuguese government cannot achieve a high rating in the future, for example, if the government can only get rated Baa1 as it did in April, 2011, this national infrastructure bank should be private and should

not be just a subsidiary of the Portuguese government. Otherwise, this national infrastructure bank will meet a rating ceiling, which is the rating of the Portuguese government. In the second case, the Portuguese government needs to allocate a significant amount of capital and few debts to the national infrastructure bank to help it achieve a much lower debt to capital ratio than the one of the Portuguese government. At the same time, the Portuguese government should have absolute control over the Portuguese infrastructure bank by holding more than 51 percentage of the total equity.

Chapter 5 Megaregions and HSR Financing examines the economic influence of HSR on megaregions, and captures part of these economic benefits to finance the building of Portuguese HSR projects using value capture mechanisms. This chapter concludes that HSR can bring significant economic benefits to the adjacent area of the HSR stations: HSR significantly increases the real estate or land value, and promotes the business of service industry, such as “information exchange industries”, retail and accommodation industries, near HSR stations. However, it is hard to find literature modeling and quantifying the comprehensive regional impacts of HSR.

We can use value capture mechanisms to capture these economic benefits in megaregions resulting from the building of Portuguese HSRs, and use these revenues to help finance the Portuguese HSR construction. These value capture mechanisms include Tax Increment Financing, Business Development District/Special Assessment, Business rate levy, Land value tax, Development impact tax, Versement Transport, Land lease, Direct development, and Consumption tax/ income tax. The details of these value capture mechanisms are illustrated in Table 5-6, and Table 5-7.

Considering all financial stability, social equity, and feasibility, we find no value capture mechanisms can be superior to the others. Some value capture mechanisms have good financial stability, but bad social equity, e.g. land value tax; some has good social equity, but bad financial stability, e.g. tax increment financing; some has good financial stability and good social equity, but bad feasibility, e.g. Versement Transport. The only feasibility constraint is whether new HSR stations will be built: if new HSR stations are not built, development impact tax, land lease and direct development will all be infeasible.

The decision-making authorities of Portugal should consider the trade-off between different criteria, and choose the most appropriate ones to finance Portuguese HSR. For example, if we consider social equity (“beneficiary pays”) as the most important criterion, tax increment financing, business development district/special assessment, Versement Transport, land lease, and direct development may be chosen assuming new HSR stations will be built. If we consider financial stability as the most important criterion,

land value tax, Versement Transport, consumption tax/income tax may be chosen assuming new HSR stations will be built. If we consider feasibility as the most important criterion, tax increment financing, business development district/special assessment, direct development, Land lease, and development impact tax may be chosen.

Finally, it is necessary to combine wrapped bond financing and value capture mechanisms together to address the timing issue of megaregion cash flows when financing Portuguese HSR projects: most value capture mechanisms only provides megaregion revenues when HSR enters its operating phase, and wrapped bond financing can effectively transform these future megaregion revenues into current construction funds in low financial costs. The combination is perfectly feasible in Portugal on condition that PPP is the most likely procurement method for Portuguese HSR projects in the future: in the tender invitation document issued before the bidding phase starts, the Portuguese government needs to clearly state that additional megaregion revenues are dedicated revenues for HSR projects just like HSR fare revenues, wrapped bond financing is highly recommended and the Portuguese infrastructure bank will provide monoline guarantee to support the use of wrapped bonds if necessary. This statement will significantly reduce the capital the Portuguese government needs to contribute from the public budget at the beginning, effectively counter the negative crowding out effect of HSR investments on other transportation projects in Portugal, reduce the reliance of Portugal on EU funds and EIB loans, and reduce the vulnerability of Portuguese HSR financing to EU and EIB policy change.

6.2. Future Work

This thesis has introduced various value capture mechanisms to capture the economic benefits of HSR building in megaregions, and use financial stability, social equity, and feasibility as criteria to measure these value capture mechanisms. However, due to the variance of the construction costs between different HSR projects, the variance of the economic condition of megaregions in which the HSR projects are built, and the variance of the economic benefits that HSR can bring to megaregions, this thesis cannot reach a more detailed conclusion about the revenue scale of each value capture mechanisms than rating high, medium, or low in the financial stability criterion. Further research is needed to estimate the revenue scale of these value capture mechanisms before the start of building new HSR projects in the future. These researches may include:

- A detailed investigation of the economic conditions of megaregions in which new HSR projects are built, especially the economic conditions of the urban adjacent areas of HSR stations, including GDP, average income, real estate price, land price, population density, and so on.
- A quantitative cost estimation of new Portuguese HSR projects.
- A detailed benefit-cost analysis (BCA) of new Portuguese HSR projects to make sure that these HSR projects can be built only when they are able to bring justifiable social benefits. This BCA should be done using other transportation modes as comparables, such as conventional rail projects, road projects, and so on.
- A detailed quantitative study of the economic benefits that Portuguese HSR can bring to megaregions, such as, the percentage increase in land and real estate price around HSR stations, the revenue increase of retail and accommodation businesses around HSR station, the revenue increase of information exchange industries, the comprehensive regional impacts of HSR, and so on.
- Estimation of tax rate based on public's acceptance of a new value capture tax and a new value capture tax district.
- Estimation of revenues each value capture mechanisms can provide for financing HSR based on the analysis of this thesis and the four further researches mentioned above.

6.3. A Closing Word

This thesis adds value by systematically studying the financial impacts and financing methods for HSR building in Portugal based on the assumption that Portugal will build other HSR lines only when the economy of Portugal has significantly recovered. This thesis has many contents, including crowding out effect of HSR investments, difference between financing HSR and other transportation projects, innovative methods of financing HSR, and megaregion and HSR. It require substantial amount of time and patience to finish reading this thesis, and here we would like to express our sincere thanks to all readers for your patience and attention. We hope you find our result of value.

References

Altshuler, A. A., J. A. Gomez-Ibanez and A. M. Howitt .1993. Regulation for Revenue: The Political Economy of Land Use Exactions. The Brookings Institution and Lincoln Institute of Land Policy, Washington, D.C.

Astrid Gühneman. 2005. *Deliverable 1 Task Report Case Study: Infrastructure Funding in Germany*. Retrieved November 7th, 2010 from <http://www.econ.kuleuven.be/projects/funding/downloads/Germany.pdf>

Baidu Baike Website, 2010. Guangzhou-Shenzhen-Zhuhai Expressway. Retrieved Nov, 2010 from <http://baike.baidu.com/view/1074491.htm>

Bahnprojekt Stuttgart-Ulm, Official Website. 2010a. The Stuttgart-Ulm Rail Project. Retrieved Nov, 2010 from <http://www.das-neue-herz-europas.de/en-gb/the-stuttgart-ulm-rail-project/default.aspx>

Bahnprojekt Stuttgart-Ulm, Official Website. 2010b. Facts & Figures. Retrieved Nov, 2010 from <http://www.das-neue-herz-europas.de/en-gb/facts--figures/default.aspx>

Bi, Mingxin. 2011. High-Speed Rail Broadens Range of Options for China's New Year Travel. Xinhuanet Website, February 4th, 2011. Retrieved March, 2011 from http://news.xinhuanet.com/english2010/china/2011-02/04/c_13719070.htm

BizTimes Website. 2011. Wisconsin left out of latest high-speed rail funding allocation. Retrieved May, 2011 from <http://www.biztimes.com/daily/2011/5/9/wisconsin-left-out-of-latest-high-speed-rail-funding-allocation>

Blum, U., Haynes, K.E., Karlsson, C. 1997. Introduction to the Special Issue: The Regional and Urban Effects of High-Speed Trains. *The Annals of Regional Science*, 31, pp. 1–20.

BMVBS, Official Website. 2010a. *Federal Transport Infrastructure Plan 2003*. Retrieved November 7th, 2010 from <http://www.bmvbs.de/SharedDocs/EN/Artikel/UI/federal-transport-infrastructure-plan-2003.html>

BMVBS, Official Website. 2010b. *Federal Transport Infrastructure Plan 2003*. Retrieved November 7th, 2010 from <http://www.bmvbs.de/cae/servlet/contentblob/29172/publicationFile/3228/federal-transport-infrastructure-plan-2003.pdf>

British BIDs, Official Website. 2011. Welcome to British BIDs. Retrieved March, 2011 from <http://www.britishbids.info/Home.aspx>

Catan, Thomas. 2009. Spain's Bullet Train Changes Nation -- and Fast. Wall Street Journal Website, April 29th, 2009. Retrieved March 2011 from <http://online.wsj.com/article/SB124018395386633143.html>

Chiang, John. 2009. California State Controller's Annual Report on Redevelopment Agencies, 2007-2008. Retrieved March, 2011 from http://www.sco.ca.gov/Files-ARD-Local/LocRep/redevelop_fy0708redev_reports.pdf

Chinese Foreign Investment Website. 2010. The Total Fixed Asset Investment of Chinese Aviation Industry Will Reach 90 Billion RMB In 2010. Retrieved Nov, 2010 from <http://www.china-186.com/Article/news/201001/13497.html>

CITIC Securities. 2003. Proposal for the Refinancing Project of Shanghai International Airport Company. Retrieved Nov, 2010 from <http://doc.mbalib.com/view/42fb95f27701cfdc8ebbca8f01c29537.html>

Civil Aviation Administration of China, Official Website. 2008. Retrieved Nov 8th from <http://www.iicc.com.cn/jtzt/jtfz/cjzs/mh/200812/31740.html>

Cook County Clerk's Office, Official Website. 2007. City of Chicago TIF Revenue Totals by Year 1986-2006. Retrieved March, 2011, from http://www.cookctyclerk.com/pdf/Chicago_TIF_revenue.pdf

Cooper, Chris and Matsuda, Kiyotaka. 2011. Japanese Bullet-Train Back on Track. Independent Online, April 29th, 2011. Retrieved April, 2011 from <http://www.iol.co.za/business/companies/japanese-bullet-train-back-on-track-1.1062369>

Council For Economic Planning and Development, Official Website. 2010. The i-Taiwan 12 Projects. Retrieved Nov 2010 from <http://www.cepd.gov.tw/encontent/m1.aspx?sNo=0000062>

Council For Economic Planning and Development, Official Website. 2011. The New Ten Major Construction Projects. Retrieved April, 2011 from <http://www.cepd.gov.tw/m1.aspx?sNo=0001540&ex=1&ic=0000015>

Defense Housing Australia, Official Website. 2011. Land Tax. Retrieved March, 2011 from <http://www.invest.dha.gov.au/dha/home/info/landtax.sok>

Demographia. 2011. Demographia World Urban Areas: 7th Annual Edition. Retrieved April, 2011 from <http://www.demographia.com/db-worldua.pdf>

Department of Transport (the UK), Official Website. 2010. High-Speed Rail. The Stationary Office. London, the United Kingdom. Retrieved April, 2011 from <http://www.dft.gov.uk/pgr/rail/pi/highspeedrail/>

Doherty, Matthew. 2004. Funding Public Transport Development through Land Value Capture Programs. Retrieved March, 2011 from http://ecotransit.org.au/ets/files/land_value_capture_mdoherty2004.pdf

Dunn, Travis. 2008. The Co-evolution of Surface Transportation Technology and Strategy Development, MIT-Portugal Program Working Paper, MIT, Cambridge, MA.

East Japan Railway Company (JE East), Official Website. 2004. "Ecute" Commercial Areas. Retrieved March, 2011 from <http://www.jreast.co.jp/e/press/20040501/index.html>

East Japan Railway Company (JE East), Official Website. 2010a. Annual Financial Report of 2010. Retrieved March, 2011 from http://www.jreast.co.jp/e/investor/ar/2010/pdf/ar_2010_all.pdf

East Japan Railway Company (JE East), Official Website. 2010b. Overview of Operation: Non-Transportation Activities. Retrieved March, 2011 from http://www.jreast.co.jp/e/investor/ar/2010/pdf/ar_2010_09.pdf

European Commission. 2004. Resource Book on PPP Case Studies. Retrieved Nov 2010 from http://ec.europa.eu/regional_policy/sources/docgener/guides/pppresourcebook.pdf

EuRail, Official Website .2011. ICE High-Speed Train. Retrieved February, 2011 from <http://www.eurail.com/planning/trains-and-ferries/high-speed-trains/ice>

European Commission. 2005. Ten-T Priority Axes and Projects 2005. Retrieved Jan, 2011 from http://ec.europa.eu/ten/transport/projects/doc/2005_ten_t_en.pdf

European Commission, Official Website. 2011. TEN-T / Transport Infrastructure. Retrieved March, 2011 from http://ec.europa.eu/transport/infrastructure/networks_eu/rails_en.htm

European Investment Bank, Official Website. 2011a. Strategy. Retrieved January, 2011 from <http://www.eib.org/about/strategy/index.htm>

European Investment Bank, Official Website. 2011b. Products and Services. Retrieved January, 2011 from <http://www.eib.org/about/strategy/index.htm>

European Investment Bank, Official Website. 2011c. Loans. Retrieved January, 2011 from <http://www.eib.org/products/loans/index.htm>

European Investment Bank, Official Website. 2011d. Guarantees. Retrieved January, 2011 from <http://www.eib.org/products/loans/index.htm>

European Investment Bank. 2011e. Transparency Policy. Retrieved January, 2011 from http://www.eib.org/attachments/strategies/transparency_policy_en.pdf

European Investment Bank, Official Website. 2011f. Structure and Organization. Retrieved April, 2011 from <http://www.eib.org/about/faq/structure/index.htm#what-is-the-eib>

European Investment Bank. 2011g. EIB Group: Key Statutory Figures. Retrieved April, 2011 from http://www.eib.org/about/key_figures/index.htm

European PPP Expertise Centre. 2010. Capital Markets in PPP Financing. Retrieved Jan 2011 from http://www.eib.org/epec/07_MT_EPEC_CAPITAL_MARKETS.pdf

Everett Ehrlich and Felix G. Rohatyn. 2008. A New Bank to Save Our Infrastructure. Retrieved Jan 2011 from <http://www.nybooks.com/articles/archives/2008/oct/09/a-new-bank-to-save-our-infrastructure/>

ExpatsPortugal, Official Website. 2011. Property Buying in Portugal. Retrieved March, 2011 from <http://www.expatsportugal.com/property.php>

Federal Highway Administration (FHWA). 2009. Public-Private Partnerships for Highway Infrastructure: Capitalizing on International Experience. Retrieved September 2009 from http://international.fhwa.dot.gov/links/pub_details.cfm?id=642

FitchRating. 2010. High-Speed Rail Projects: Large, Varied and Complex. Retrieved March, 2011 from <http://www.scribd.com/doc/29507989/High-Speed-Rail-Projects-Fitch>

Froymovich, Riva. 2011. EU Barroso: Portugal Bailout Request Will Be Processed Swiftly. Wall Street Journal, April 6th, 2011. Retrieved April 2011 from <http://online.wsj.com/article/BT-CO-20110406-712311.html>

Gao, Jianghong. 2008. Chairman of Beijing-Shanghai HSR company show you where the 220.9 billion project funds comes from. Sina Website, April 19th, 2008. Retrieved Nov, 2010 from <http://news.sina.com.cn/c/2008-04-19/023615386175.shtml>

Governor's Office of Planning and Research (California), Official Website. 1997. A Planner's Guide to Financing Public Improvements. Retrieved April, 2011 from <http://ceres.ca.gov/planning/financing/chap3.html#chap3>

GovTrack.US, Official Website. 2011. H.R. 2521: National Infrastructure Development Bank Act of 2009. Retrieved April, 2011 from <http://www.govtrack.us/congress/bill.xpd?bill=h111-2521>

Guangdong Airport Group. 2010. Problems and Solutions of Airport Location-Based Reform. Retrieved Nov, 2010 from <http://www.shgz.gov.cn/gb/gzw/xxzh/mrjj/hyxx/userobject1ai31495.html>

Hall, Peter. 2009. Looking Backward, Looking Forward: The City Region of the Mid-21st Century. Regional Studies, Vol. 43.6, pp. 803–817.

Hirota, R. 1984. Present Situation and Effects of the Shinkansen. Paper presented at the International Seminar on High-Speed Trains.

Higgs, Robert. 2011. Gov. John Kasich Successful In Halting \$400 Million, High-Speed Rail Project: Politifact Ohio. Cleveland Website, January, 2011. Retrieved May, 2011 from http://www.cleveland.com/open/index.ssf/2011/01/kasich_successful_in_halting_4.html

Iacono, Michael, Levinson, David, and Zhao, Jerry. 2009. Value Capture for Transportation Finance. Retrieved March, 2011 from <http://nexus.umn.edu/Papers/ValueCapture.pdf>

Illinois Government News Network (Official Website). 2011. Governor Quinn, Senators Durbin, Kirk Announce \$186 Million for Chicago to St. Louis High Speed Rail Funding Rejected by Florida Will Improve Chicago to St. Louis Route. Retrieved May, 2011 from <http://www.illinois.gov/PressReleases/ShowPressRelease.cfm?SubjectID=2&RecNum=9385>

Innes, Judith E. Booher, David E. Vittorio, Sarah Di. 2010. Strategies for Megaregion Governance. *Journal of the American Planning Association*, Vol.77, No.1

International Union of Railway, Official Website. 2011. General Definitions of Highspeed. Retrieved March, 2011 from <http://www.uic.org/spip.php?article971>

International Business Times. 2011. European Sovereign Debt Crisis Coverage. Retrieved April, 2011 from <http://africa.ibtimes.com/topics/detail/892/european-sovereign-debt-crisis-coverage/>

I-Tsung Tsai. 2007. *Default and Renegotiation: Financial Structure and Incentive in Public Private Partnership Contracts*. PhD Dissertation, MIT, Cambridge, MA.

José Pavão Nunes. 2007. Pension Funds in Portugal. Retrieved Jan 2011 from <http://www.oecd.org/dataoecd/12/3/38787240.pdf>

Kenneth Orski. 2008. Financing the Nation's Infrastructure Deficit. *Innovation Briefs*. Vol. 19, No. 7 www.innobriefs.com

Khalip, Andrei. 2011. Socrates Election Plan Echoes Portugal Bailout Terms. Reuters Website, April, 27th. Retrieved May, 2011 from <http://www.reuters.com/article/2011/04/27/portugal-socialists-idUSLDE73Q2DB20110427>

Kowsmann, Patricia. 2011. Portugal Opposition Vows to Go Beyond EU Bailout Measures. *Wall Street Journal Website*, May 9th, 2011. Retrieved May, 2011 from <http://online.wsj.com/article/BT-CO-20110509-706583.html>

Lari, A., D. Levinson, Z. J. Zhao, M. Iacono, S. Aultman, K. V. Das, J. Junge, K. Larson and M. Scharenbroich. 2009. Value Capture for Transportation Finance: Technical Research Report. CTS 09-18. Center for Transportation Studies, University of Minnesota.

Liang, Jingxue. 2011. The Railway Infrastructure Investment is 198 Billion RMB—6.3 Times of the Number Last Year. *China Economy Website*, March 4th, 2011. Retrieved April, 2011 from http://www.ce.cn/xwzx/gnsz/gdxw/201103/04/t20110304_22268635.shtml

Lima, Joao and Rastello, Sandrine. 2011. Portugal Debt Grade Cut Two Steps by Moody's as ECB Risks Deepening Pain. *Bloomberg Website*, March 15th, 2011. Retrieved March 20th, 2011 from <http://www.bloomberg.com/news/2011-03-15/portugal-s-long-term-bond-ratings-cut-two-levels-to-a3-from-a1-by-moody-s.html>

Loubinoux, Jean-Pierre. 2008. SNCF International in South Korea. Retrieved March 20th, 2011 from http://www.sncf-international.net/upl/file/FP_Coree-du-Sud_GB.pdf.

Martínez, Luis Miguel. 2010. Financing Public Transport Infrastructure Using the Value Capture Concept. PHD dissertation. Civil Engineering Department, IST- Technical University of Lisbon.

Martínez, Luis Miguel. Personal Communication. March 6th, 2011.

Matlock, George. 2010. Greek/German Bond Yield Spread More Than 1,000 Bps. Reuters Website, Apr 28, 2010. Retrieved April, 2011 from <http://www.reuters.com/article/2010/04/28/markets-bonds-greece-idUSLDE63R0WU20100428>

Matsumoto, Takeaki. 2011. Japan Is Open for Business. The New York Times, April 29th, 2011. Retrieved April, 2011 from <http://www.nytimes.com/2011/04/30/opinion/30iht-edmatsumoto30.html>

Minder, Raphael and Castle, Stephen. 2011. Political Divide Poses Risks for Portugal in Bailout Talks. The New York Times Website, April 7th, 2011. Retrieved April, 2011 from <http://www.nytimes.com/2011/04/08/business/global/08euro.html>

Mei, Minghua and Li, Jinzhe. 2004. *Legal risk in project finance*. Zhongxin Press.

Melibaeva, Sevara, Sussman, Joseph, and Dunn, Travis. 2010. Comparative Study of High-Speed Passenger Rail Deployment in Megaregion Corridors: Current Experiences and Future Opportunities. ESD Working Paper Series. Retrieved Feb 18th, 2011 from esd.mit.edu/wps

Meyer, Michael D. 2007. Toward a Vision for the Nation's Surface Transportation System: Policies to Transcend Boundaries and Transition to a New Era. Retrieved Feb 18th, 2011 from <http://www.america2050.org/Surface%20Transportation%20System%20-%20Meyer.pdf>

Michael Likosky. 2010. *Obama's Bank: Financing a Durable New Deal*. Cambridge University Press.

Millennium BCP. 2010. Poceirão-Caia HS Project Financing. Workshop on PPP and High-Speed Rail. Lisbon, Portugal. January, 2010.

Ministry of Finance (China). 2006. Policy for Civil Aviation Infrastructure Fund Management. Retrieved Nov, 2010 from <http://china.findlaw.cn/fagui/jj/24/67835.html>

Ministry of Internal Affairs and Communications (Japan), Official Website. 2011. Japan Statistic Yearbook 2011. Retrieved April, 2011 from <http://www.stat.go.jp/english/data/nenkan/index.htm>

Ministry of Railway (China), Official Website. 2010. Annual Statistical Report of Ministry of Railway in. Retrieved Nov, 2010 from <http://www.china-mor.gov.cn/zwgk/gongbao2009.html>

Ministry of Railway (China), Official Website. 2009. Annual Statistical Report of Ministry of Railway in 2008. Retrieved Nov, 2010 from <http://www.china-mor.gov.cn/zwgk/gongbao2008.html>

Ministry of Railway (China), Official Website. 2008. Annual Statistical Report of Ministry of Railway in 2007. Retrieved Nov, 2010 from <http://www.china-mor.gov.cn/zwgk/gongbao2007.html>

Ministry of Railway (China), Official Website. 2008. Mid-to-Long Term Railway Network Plan (Revised in 2008). Retrieved May, 2011 from http://www.china-mor.gov.cn/tljs/tlgh/201012/t20101228_732.html

Ministry of Transport (China), Official Website. 2010. Annual statistical Report of Roads, Waterways, Seaports Development in 2009. Retrieved Nov. 2010 from

http://www.moc.gov.cn/zhuzhan/tongjigongbao/fenxigongbao/hangyegongbao/201009/t20100916_811433.html

Moody's Investor Service. 2006. Construction Risk in Privately-Financed Public Infrastructure (PFI / PPP / P3) Projects. Retrieved Dec, 2011 from

<http://www.globalclearinghouse.org/InfraDev/assets%5C10/documents/Moody%27s%20-%20Construction%20Risk%20in%20PPP%20Projects%20%282006%291.pdf>

Moody's Investor Service. 2007. Request for Comment on: Operating Risk in Privately-Financed Public Infrastructure (PFI/PPP/P3) Projects. Retrieved Dec.2010 from

http://www.moody.com/Pages/amr001004.aspx?sd=1&sb=p_published_date_time

Moody's Investor Service. 2008a. Request for Comment: Impact of Grant Funding on Senior Debt Ratings in Construction Phase PFI/PPP/P3 Projects. Retrieved Nov.2010 from

http://www.moody.com/Pages/amr001004.aspx?sd=1&sb=p_published_date_time

Moody's Investor Service. 2008b. Methodology Update Report: Privately-Financed Public Infrastructure (PFI/PPP/P3) Projects with Partial Market Revenue Risk. Retrieved Dec.2010 from

http://www.moody.com/researchdocumentcontentpage.aspx?docid=PBC_111984

Moody's Investor Service. 2008c. Request for Comment: Impact of Grant Funding on Senior Debt Ratings in Construction Phase PFI/PPP/P3 Projects. Retrieved Dec.2010 from

http://www.moody.com/Pages/amr001004.aspx?sd=1&sb=p_published_date_time

Moody's Investor Service. 2009. Methodology Update Report: Public Sector Capital Contributions to Funding PFI/PPP/P3 Projects. Retrieved Dec.2010 from

http://www.pppcouncil.ca/pdf/moody_milestone_112009.pdf

Moody's Investor Service. 2010. Sector Outlook on EMEA PFI/PPP. Retrieved Jan 2011 from

<http://www.ijonline.com/Downloads/Marketing/a37ebb87-3443-49e8-a8cb-17a137ac57bc.pdf>

MOPTC. 2010. Portuguese High-Speed Rail Project Business Model. Workshop on PPP And High-Speed Rail: The Portuguese Experience. Lisbon, 28-29th January 2010.

Naukowy, Kwartalnik. 2010. Transactions Of The Institute Of Aviation. Retrieved April, 2011 from

http://ilot.edu.pl/autoinstalator/wordpress/wp-content/uploads/2011/03/PIL_205.pdf

Nelson, J. 2008. Stuck with the bill, but why? An analysis of the Portuguese public finance system with respect to surface transportation policy and investments, SM/MCP Thesis, MIT, Cambridge, MA.

NetEase Website. 2011. The Beijing-Shanghai HSR is Expected to Begin Commercial Service in June,

2011. Retrieved April, 2011 from <http://news.163.com/11/0115/03/6QDKUD2B00014AED.html>

Niu, Hongjun. 2010. Bank of China Plans to Invest 6 Billion RMB in the Beijing-Shanghai HSR Project. Sina Finance Website, April 1st, 2010. Retrieved April, 2011 from

<http://finance.sina.com.cn/stock/hkstock/ggscyd/20100401/10527676231.shtml>

Oakley, David and Hope, Kerin. 2010. Gilt Yields Rise amid UK Debt Concerns. Financial Times Website, February 18th, 2010. Retrieved April, 2011 from <http://www.ft.com/cms/s/0/7d25573c-1ccc-11df-8d8e-00144feab49a.html#axzz1LR4odDXm>

Pol, Peter. M. J. 2003. The Economic Impact of the High-Speed Train on Urban Regions. European Regional Science Association EconPapers. Retrieved Feb, 2011 from <http://econpapers.repec.org/paper/wiwwiwrse/ersa03p397.htm>

Public Construction Commission, Official Website. 2010. I-Taiwan 12 projects. Retrieved Dec.2nd from <http://ppp2.pcc.gov.tw/pcc/en/Introduction2.aspx>

Quigley, M. 2007. A Tale of Two Cities: Reinventing Tax Increment Financing. Retrieved March, 2011, from <http://www.commissionerquigley.com/library/taleoftwocities.pdf>

QQ Finance, Official Website. 2010. Shanghai Airport. Retrieved Nov, 2010 from <http://stockhtm.finance.qq.com/sstock/quotpage/q/600009.htm#6>

RAVE.2008. The Portuguese High-Speed Rail Project: General Overview and Status of the Project. RAVE's Presentation. Lisbon, Portugal. September, 2008.

RAVE.2010a. The Portuguese High-Speed Rail Project: General Overview and Status of the Project. RAVE's Presentation in Workshop on PPP and High-Speed Rail & The Portuguese Experience. Lisbon, Portugal. September, 2009.

RAVE. 2010b. The Portuguese High-Speed Rail Project: Application of Life-Cycle Contracts in High-Speed Rail Projects. Moscow, Portugal. April, 2010.

Renda, Andrea and Schrefler, Lorna. 2006. Public Private Partnerships: National Experiences in the European Union. Retrieved Nov 2010 from http://www.europarl.europa.eu/comparl/imco/studies/0602_ppp02_briefingnote_en.pdf

Rosenberg, Mike. 2011. High-Speed Rail: Two-Track Alternative Picks Up Steam in the Bay Area. MercuryNews Website, May 1st, 2011. Retrieved May 2nd, 2011 from http://www.mercurynews.com/peninsula/ci_17970647?nclick_check=1

Ross, Catherine L. 2009. Megaregions, Planning for Global Competitiveness. Ed. Catherine L. Ross. Island Press, Washington, DC.

Ross, Catherine L. and Woo Myungje. 2011. Megaregions and Mobility. Spring Issue of the Bridge on Urban Sustainability. Vol 41. Number 1.

Ross-Thomas, Emma and Meier, Simone. 2011. Portugal's Long-Term Credit Rating Is Lowered One Level to Baa1 by Moody's. Bloomberg Website, April 5th, 2011. Retrieved April 15th, 2011 from <http://www.bloomberg.com/news/2011-04-05/portugal-s-long-term-credit-rating-is-lowered-one-level-to-baa1-by-moody-s.html>

Regional Plan Association. 2006. *America 2050: A Prospectus*. National Committee for American 2050. New York.

Sakamoto, Ryusuke. Personal Communication, Jan 17, 2011.

Sands, Brian D. 1993. *The Development Effects of High-Speed Rail Stations and Implications for California*. UCTC No. 115. University of California, Institute of Urban & Regional Development, Berkeley. April. Retrieved Feb. 2011 from <http://www.uctc.net/papers/115.pdf>

Santos, Rui Emanuel Figueiredo Dos. Personal Communication. March 10th, 2011.

Sasaki, K., Ohashi, T. and Nado, A. 1997. High-Speed Rail Transit Impact on Regional Systems: Does the Shinkansen Contribute to Dispersion? *The Annals of the Regional Science*, 31, pp. 77-98.

Schütz E, 1998, *Stadtentwicklung durch Hochgeschwindigkeitsverkehr (Urban development by High-Speed Traffic)* Heft 6, 1998, pp 369 – 383.

Shima, Takashi. 2007. Taiwan High-Speed Rail. *Japan Railway & Transport Review* (48), August 2007. Retrieved April, 2011 from http://www.jrtr.net/jrtr48/pdf/f40_Shi.pdf

SIGIMI. 2011. Geographic Information System for Council Tax on Real Estate (Portuguese). Retrieved March, 2011 from <http://www.e-financas.gov.pt/SIGIMI/default.jsp>

Sina Finance, Official Website. 2010. Ganyue Expressway. Retrieved Nov, 2010 from http://vip.stock.finance.sina.com.cn/corp/go.php/vCI_StockHolder/stockid/600269/displaytype/30.phtml

Sina Finance, Official Website. 2011. Stock Market in China. Retrieved April, 2011 from <http://finance.sina.com.cn/stock/index.shtml>

Spegele, Brian. 2011. China Puts Brakes on High-Speed Trains. *Wall Street Journal Website*, April 15th, 2011. Retrieved April 2011 from <http://online.wsj.com/article/SB10001424052748703983104576262330447308782.html>

Taiwan High-Speed Rail, Official Website. 2011. Company Overview. Retrieved April, 2011 from http://www.thsrc.com.tw/en/about/ab_comp.asp

The City of San Diego, Official Website. 2011. Business Improvement Districts. Retrieved March, 2011 from <http://www.sandiego.gov/economic-development/business-assistance/small-business/bids.shtml>

The Civil Aviation Administration of China, Official Website. 2006. Overview of Chinese Civil Aviation Industry. Retrieved Nov, 2010 from http://www.caac.gov.cn/H1/H2/200612/t20061225_947.html

The Civil Aviation Administration of China, Official Website. 2007. Statistical report of Chinese Civil Aviation Industry Development in 2006/2007. Retrieved Nov, 2010 from http://www.caac.gov.cn/H1/H2/200711/t20071130_9431.html

The Civil Aviation Administration of China, Official Website. 2008. Statistical Report of Chinese Civil Aviation Industry Development in 2007/2008. Retrieved Nov, 2010 from http://www.caac.gov.cn/H1/H2/200808/t20080828_18587.html

The Civil Aviation Administration of China, Official Website. 2011. The responsibility of the Civil Aviation Administration of China. Retrieved April, 2011 from <http://www.caac.gov.cn/G1/G2/>

The Economic Observer Online. 2008. Amidst GDP Slump, China Pours Investment in Railways. Retrieved, March, 2011 from <http://www.eeo.com.cn/ens/Industry/2008/10/30/118097.html>

The European Commission, the International Monetary Fund, and the European Central Bank. 2011. Portugal: Memorandum of Understanding Specific Economic Policy Conditionality. Retrieved, May, 2011 from http://economico.sapo.pt/public/uploads/memorandotroika_04-05-2011.pdf

The Transport Politic, Official Website. 2010. Hong Kong's Expanding Metro a Model of Development-Funded Transit. Retrieved March, 2011 from <http://www.thetransportpolitic.com/2010/12/14/hong-kongs-expanding-metro-a-model-of-development-funded-transit/>

The World Bank, Official Website. 2011a. World Development Indicators. Retrieved April, 2011 from http://data.worldbank.org/data-catalog/world-development-indicators?cid=GPD_WDI

The World Bank, Official Website. 2011b. Doing Business in Portugal 2011. Retrieved March, 2011 from <http://www.doingbusiness.org/~media/FPDKM/Doing%20Business/Documents/Profiles/Country/DB11/PRT.pdf>

Transport for London (TfL). 2003. London Travel Report. Transport for London, London.

UK Legislation, Official Website. 2011. Local Government Act 2003. Retrieved March, 2011 from <http://www.legislation.gov.uk/ukpga/2003/26/contents>

Vickerman, Roger. 1997. High-Speed Rail in Europe: Experience and Issues for Future Development. *The Annals of Regional Science*, Vol. 31, pp. 21–38.

Vidal, John 2010. UN report: World's Biggest Cities Merging into 'Megaregions'. Retrieved Feb 8th, 2011 from <http://www.guardian.co.uk/world/2010/mar/22/un-cities-mega-regions>

Williams, Timothy. 2011. Florida's Governor Rejects High-Speed Rail Line, Fearing Cost to Taxpayers. *The New York Times Website*, February 16th, 2011. Retrieved April, 2011 from <http://www.nytimes.com/2011/02/17/us/17rail.html>

Wikipedia. 2010a. Expressways of China. Retrieved Nov, 2010 from http://en.wikipedia.org/wiki/National_Trunk_Highway_System

Wikipedia. 2011a. Tōkaidō Shinkansen. Retrieved Feb 18th, 2011 from http://en.wikipedia.org/wiki/T%C5%8Dkaid%C5%8D_Shinkansen

Wikipedia. 2011b. Tax Increment Financing. Retrieved March 4th, 2011 from http://en.wikipedia.org/wiki/Tax_increment_financing

Wikipedia. 2011c. Business Improvement District. Retrieved March, 2011 from http://en.wikipedia.org/wiki/Business_improvement_district

Wikipedia. 2011d. Land Value Tax. Retrieved March, 2011 from http://en.wikipedia.org/wiki/Land_value_tax

Wikipedia. 2011e. Consumption Tax. Retrieved March, 2011 from http://en.wikipedia.org/wiki/Consumption_tax

Wikipedia. 2011f. Transport in Japan. Retrieved Jan. 2011 from http://en.wikipedia.org/wiki/Transport_in_Japan

Wikipedia. 2011g. Chūbu Centrair International Airport. Retrieved Jan. 2011 from http://en.wikipedia.org/wiki/Ch%C5%ABbu_Centrair_International_Airport

Wikipedia. 2011h. Income Tax. Retrieved March, 2011 from http://en.wikipedia.org/wiki/Income_tax

Wikipedia. 2011i. High-Speed Rail in China. Retrieved May, 2011 from http://en.wikipedia.org/wiki/High-speed_rail_in_China

World Economic Forum. 2008. The Global Competitiveness Index rankings Retrieved March, 2011 from <http://www.weforum.org/pdf/gcr/2008/rankings.pdf>.

Zhang, Hanshu. 2010. Two Ways for the Beijing-Shang HSR Company Stock IPO. Huaxia Newspaper, August 21st, 2010. Retrieved Nov, 2010 from <http://business.sohu.com/20100821/n274367703.shtml>

Appendix A: Current Events of Relevance

This thesis is writing when many big HSR-related events happen around the world, for example the economic bailout in Portugal, the rejection of HSR in Florida, and so on. To make this thesis especially timely, this Appendix A discusses all these late-breaking events and their relevance to the arguments in this thesis.

Portugal

Economic Bailout of Portugal by the European Union (EU) and the International Monetary Fund (IMF)

This issue has been discussed in detail in Chapter 1, *Introduction*.

The Snap General Selection in Portugal and Its Influence

Currently, there are two primary political parties in Portugal: the Socialist party represented by the caretaker Prime Minister Jose Socrates, and the main opposition Social Democratic Party (PSD). There will be a snap general election on June 5th, 2011.

However, no matter which parties get elected, Portugal will experience an unprecedented austerity just as the bailout agreement required in the near future. According to Khalip (2011), in the Socialist party's manifesto, Socrates expressed his opinion that "Portugal had to put its finances in order by cutting the budget deficit and stabilizing its debt load." He said "We will conduct a demanding budget consolidation programme, intervening more on the side of spending cuts, but without compromising the foundations of the social state."

On the other hand, according to Kowsmann (2011), Portugal's main opposition party "has vowed to take measures to cut public spending, including sharply shrinking the size of the government, which it claims go well beyond those being imposed by the European Union and the International Monetary Fund under a EUR78 billion bailout agreement." The leader of the PSD, Pedro Passos Coelho, said: "This is a plan that takes tough, brave and ambitious measures with the goal to address the dramatic situation that the country is in, we have a goal and vision for Portugal that go beyond the economic targets set under the bailout."

Source: 1) Khalip, Andrei. 2011. Socrates Election Plan Echoes Portugal Bailout Terms. Reuters Website, April, 27th. Retrieved May, 2011 from <http://www.reuters.com/article/2011/04/27/portugal-socialists-idUSLDE73Q2DB20110427>

2) Kowsmann, Patricia. 2011. Portugal Opposition Vows to Go Beyond EU Bailout Measures. Wall Street Journal Website, May 9th, 2011. Retrieved May, 2011 from <http://online.wsj.com/article/BT-CO-20110509-706583.html>

China

China Slows Down Its HSR Speed (April 15th, 2011)

According to Spegele (2011), China will begin to operate its HSR trains at lower speed due to safety concern and energy consideration. Sheng Guangzu, head of China's Ministry of Railways, said "High-Speed Trains will begin operating at a maximum 300 kilometers an hour from July 1, compared with previous speeds of around 350 kilometers an hour."

The slowing down of China's HSR is due to the safety concern and energy consideration. According to Spegele (2011), an executive at a non-Chinese High-Speed Train manufacturer said "running trains above speeds of 330 kilometers an hour poses safety concerns and higher costs. At that speed threshold, wheels slip so much that you need bigger motors and significantly more electricity to operate. There is also so much wear on the tracks that costs for daily inspections, maintenance and repairs go up sharply. That's why in Europe, Japan and Korea no operators run trains above 320 kilometers an hour."

In addition, energy can be saved significantly when slowing down the speed of HSR: trains operating at 350 kilometers per hour needs to consume 100% more energy than those operating at 200 kilometers per hour.

Source: Spegele, Brian. 2011. China Puts Brakes on High-Speed Trains. Wall Street Journal Website, April 15th, 2011. Retrieved April 2011 from <http://online.wsj.com/article/SB10001424052748703983104576262330447308782.html>

Japan

Japanese Shinkansen Back on Track (April 29th, 2011)

The Shinkansen, the bullet train connecting Tokyo and Tohoku region, operated by JR East, was fully open for business again on April 29, 2011. According to Cooper and Matsuda (2011), JR East reopened service from Tokyo to Fukushima, "where the disasters triggered the world's worst nuclear accident since

1986”, in early April, 2011 and extended it to Sendai on April 25th. On April 29th, 2011, the final leg was open and this would allow passengers to “ride all 714km between Tokyo and Shin-Aomori, and access the Akita bullet-train line.”

The reopening of the Japanese Shinkansen may create a symbolic effect for both the Japanese people and other countries. On April 29th, 2011, when the Shinkansen connecting Tokyo and Tohoku region became fully operational again, Takeaki Matsumoto, the Japan’s minister for foreign affairs, talked to The New York Times that “The Great East Japan Earthquake and Tsunami are the worst natural disasters Japan has encountered since the end of the Second World War. However, Japan will not simply rebuild what used to be, but aim for an innovative reconstruction that focuses on the future by fully mobilizing its signature strength: a society with high levels of technology, safety and security.” The reopening of the Japanese Shinkansen is one of the examples that Takeaki mentioned to support his view that Japan was courageous and was open for business again. (Matsumoto, 2011)

Source: 1) Cooper, Chris and Matsuda, Kiyotaka. 2011. Japanese Bullet-Train Back on Track. Independent Online, April 29th, 2011. Retrieved April, 2011 from <http://www.iol.co.za/business/companies/japanese-bullet-train-back-on-track-1.1062369>

2) Matsumoto, Takeaki. 2011. Japan Is Open for Business. The New York Times, April 29th, 2011. Retrieved April, 2011 from <http://www.nytimes.com/2011/04/30/opinion/30iht-edmatsumoto30.html>

The United States

Ohio’s Governor Rejects High-Speed Rail Line

According to Higgs (2011), in the end of 2010, the Ohio’s Governor John Kasich rejected the 400 million USD federal fund for a 258 mile HSR project to connect Cincinnati, Cleveland and Columbus. Kasich “rejected the idea as too expensive for Ohio (it would require an annual \$17 million subsidy) and unlikely to draw ridership to pay those expenses.”

This Ohio case shows that the operating costs of HSR can be so significant that the government may not even be able to afford these.

Source: Higgs, Robert. 2011. Gov. John Kasich Successful In Halting \$400 Million, High-Speed Rail Project: Politifact Ohio. Cleveland Website, January, 2011. Retrieved May, 2011 from http://www.cleveland.com/open/index.ssf/2011/01/kasich_successful_in_halting_4.html

Florida's Governor Rejects High-Speed Rail Line

On February 16th, 2011, Florida Governor Rick Scott (R) announced to give up the state's High-Speed Rail project linking Tampa with Orlando because this HSR project had to be fund mostly by the state government eventually even though the federal government provided 2.4 billion USD at the beginning. (William, 2011)

Mr. Scott's announcement is a little more than a week after Vice President Joseph R. Biden Jr. "called for spending \$53 billion on passenger trains and High-Speed Rail projects over the next six years as part of the administration's goal of making High-Speed Rail accessible to 80 percent of Americans within 25 years." (William, 2011)

At a news conference in Tallahassee on Wednesday, Mr. Scott said that "cost overruns related to the Tampa-to-Orlando line could leave Florida taxpayers stuck with a \$3 billion tab. Further, he said that if the state deemed the project too costly after having started construction, it would be required to return the \$2.4 billion to the federal government." In addition, Mr.Scott also believed that revenue estimates are too optimistic, and state taxpayers may need to provide subsidies to keep the HSR line running. (William, 2011)

Source: Williams,Timothy. 2011. Florida's Governor Rejects High-Speed Rail Line, Fearing Cost to Taxpayers. The New York Times Website, February 16th, 2011. Retrieved April, 2011 from <http://www.nytimes.com/2011/02/17/us/17rail.html>

California May Run the HSR Trains through the Bay Area on Two Tracks Instead of Four (May 2nd, 2011)

According to Rosenberg (2011), due to the budget constraint in California, the state may "spend most of the \$1.5 billion to electrify the two Caltrain tracks between San Francisco and San Jose, putting on hold its plan to spend four times as much to wipe out the historic rail line and build four new tracks along the corridor." This is a major shift that could start the project earlier, decrease the cost from 6.1 billion to 1.5 billion but also decrease the speed of the HSR trains.

Although the California may turn to the two tracks now, Jeff Barker, deputy director for the California High-Speed Rail Authority, insisted that "the two-track plan is only a start", and "we will finally need a four-track system by 2035."

This California case shows that although the method of building new dedicated High-Speed Rail lines and use new trains can result in better service and higher speed than the method of upgrading existing conventional railway lines, people may not be able to afford the expensive costs of building new dedicated HSR lines and turn to other options.

Source: Rosenberg, Mike. 2011. High-Speed Rail: Two-Track Alternative Picks Up Steam in the Bay Area. MercuryNews Website, May 1st, 2011. Retrieved May 2nd, 2011 from http://www.mercurynews.com/peninsula/ci_17970647?nclick_check=1

Wisconsin Wanted Part of Rejected Fund Back (May 11th, 2011)

According to BizTimes (2011), in December, 2010, Wisconsin Gov. Scott Walker rejected “the 810 million USD that the federal government had allocated last year to establish a Milwaukee-to-Madison High-Speed Rail line.” And in May, 2011, Wisconsin got nothing from the new 2 billion USD funding allocations for High-Speed Rail projects throughout the country announced on May 9th, 2011, although the state “applied for \$150 million in High-Speed Rail funding for upgrades to the Milwaukee to Chicago Hiawatha Amtrak rail line.”

According to BizTimes (2011), Walker said “he rejected the federal funding for the Milwaukee-to-Madison line because the state could not afford the operating costs. Those annual costs were estimated at \$7.5 million, but a federal reimbursement formula could have reduced it to as low as \$750,000 per year.”

In addition, Walker said “he supported funding to upgrade the Hiawatha line because he preferred to improve an established and successful rail line rather than attempt to establish a new line to a smaller market (Madison). The Hiawatha Service had 783,060 riders in fiscal 2010, up 6.1 percent from fiscal 2009. The previous ridership record for the Hiawatha was in 2008, when it served 749,000 riders.”

This Wisconsin case also shows that the operating costs of HSR very significant and governments may not be willing to build HSR even when they don’t need to pay the construction costs.

Source: BizTimes Website. 2011. Wisconsin left out of latest high-speed rail funding allocation. Retrieved May, 2011 from <http://www.biztimes.com/daily/2011/5/9/wisconsin-left-out-of-latest-high-speed-rail-funding-allocation>