



Massachusetts Institute of Technology
Engineering Systems Division

ESD Working Paper Series

Literature Review of Papers relevant to the topic of development impacts and economic evaluation methods of High-Speed Rail (HSR)

compiled by
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Sevara Melibaeva, MST May 2010
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Faculty Advisor:
Professor Joseph Sussman
Department of Civil and Environmental Engineering
and Engineering Systems Division



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Preface

With HSR continuing to the target of investments around the world, with even the United States elevating the place of HSR on the public agenda, we thought this compendium of summaries of references on HSR and related topics would be of value.

We begin with references on transportation investment and economic development in general. Then we consider the case of HSR and economic development on the local and urban as well as the national regional levels,

Some references on economic geography and disparities among regions are included. We include references for demand forecasting and some general references in the HSR field, and conclude with references on Transportation Project (Including HSR Projects) Financing and Value Capture Mechanisms.

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A. Economic Development Effects Promoted by Transport Investment in General

Authors: Banister, D. and Berechman, Y. (2000)
Title: *Transport Investment and Economic Development.*
UCL Press, UK and USA

Summary:

Part I: Objectives and scope

Chapter 1 - Background and objectives

It is strongly believed that transport infrastructure investment is related with economic growth and this relationship has been widely used to justify the allocation of funds to the transport sector. Generally speaking, arguments for transport investments are the relief of congestion and the fundamental link with the growth of GDP. Also, it is supported that in combination with appropriate policies, urban and regional development can happen. Banister and Berechman are concerned with the relationship of transport infrastructure and economic development and question the effects of the first to the latter. They believe that in developing countries and cities, the relationship does exist and is quite clear, but in developed countries those links are unclear. Specifically for developed countries, they are arguing that additional transportation investment has little impact on the overall accessibility and has as a result the change of business patterns and mode trends and not economic growth. The key questions they set to answer are:

1. "Is the growth impact of any new transport link in developed countries likely to be significant?"
2. Are transport costs a small part of total production and labor costs?
3. Are buoyant local economic conditions more important than transport infrastructure improvements in generating growth?
4. Are the unique characteristics of the area and the spatial extent over which the growth impacts are to be felt considered?
5. Can one generalize about the results from specific case studies?
6. What is the role of technological change in affecting the relationships between transport investment and economic growth?
7. How slow, long term and complex are the adjustment and readjustment processes within the regional economy following a transport investment?
8. Does a good transport infrastructure raise the image and perceptions of an area, thereby attracting additional private investments?
9. How can one assess the course of economic development in an area if the transport investment was not made?

10. What is the role of expectations, regarding the impacts of investment, in achieving growth?"

Chapter 2 - Scope of analysis: Definitions, approach and methodological framework

First of all, there is a difference between the expressions of economic growth and economic development. The first applies to the case when studying the changes in the GDP, whereas the second when studying the effect on additional investment on the urban and regional levels. It is stated that the degree that a transport infrastructure improvement affects economic development depends on the economic and geographical characteristics of the region where it is applied and also on the level and performance of the investment capital infrastructure. The methodological framework followed by Banister and Berechman is depicted in Figure 1.

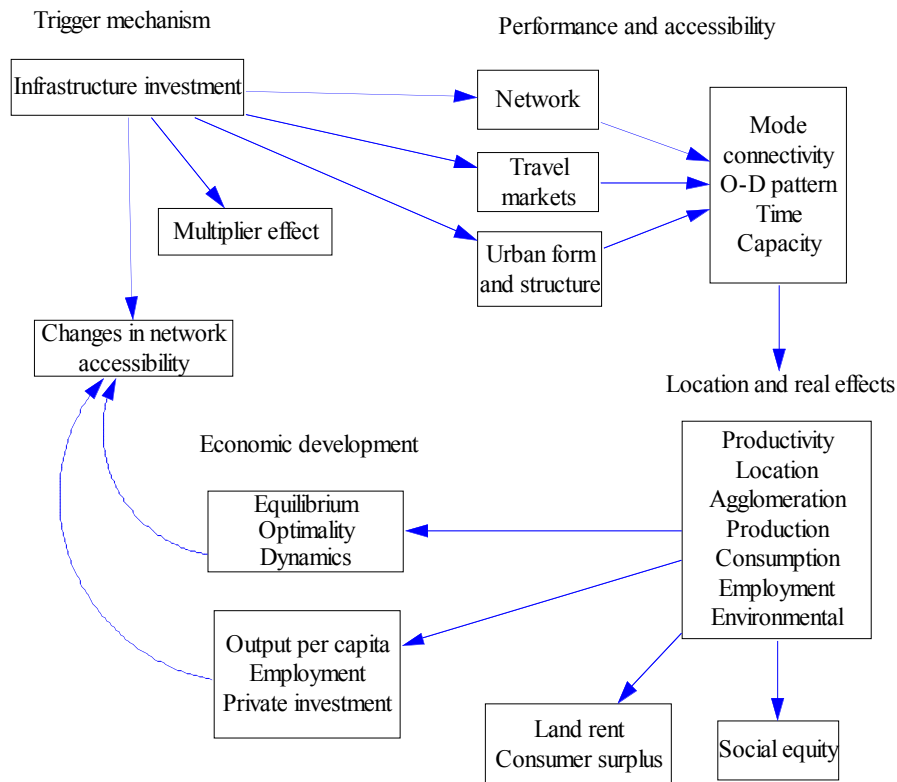


Figure 1: The basic causality paradigm of the relationships between transport infrastructure investment and economic development (source: Banister and Berechman, 2000)

Part II: Contemporary issues

Chapter 3 - Transport infrastructure investments

The analytical issues discussed in this chapter are:

1. "Definition of transportation infrastructure types
2. Pricing and financing
3. Public and private sector - the role of each sector and their collaboration
4. Risk of selecting the wrong project to implement and uncertainty on the forecasts of demand and costs"

Chapter 4 - The evolving economy

In this chapter, an extended discussion is presented, from the point of view of economic evolution and travel demand.

1. "Changing work and leisure patterns
2. Economic and technological changes
3. Global cities and spatial change"

Chapter 5 - Social, spatial and environmental effects

This chapter discussed the following topics from the point of view of economic evolution and travel demand.

1. "Demographic changes
 - a. Ageing and changing family structures (household size, increase of women in labor force etc)
 - b. The motorization effect
2. Spatial and social equity effects
3. Environmental and sustainability effects

The environmental cost of transport has been categorized into four groups:

- I: Pollutants (Carbon dioxide, nitrogen oxides, sulphur dioxide, carbon monoxide, benzene, lead, hydrocarbons and particulates)
 - II: Resources (Oil, land take, ecology, ecosystems and accidents)
 - III: Environment (Noise, vibration, community severance, visual impact and aesthetics, conservation and townscape)
 - IV: Development (Regional development, local economic impacts, congestion, urban sprawl and construction effects)
4. Urban form and structure"

Part III: Methodology – analytical approaches and modeling

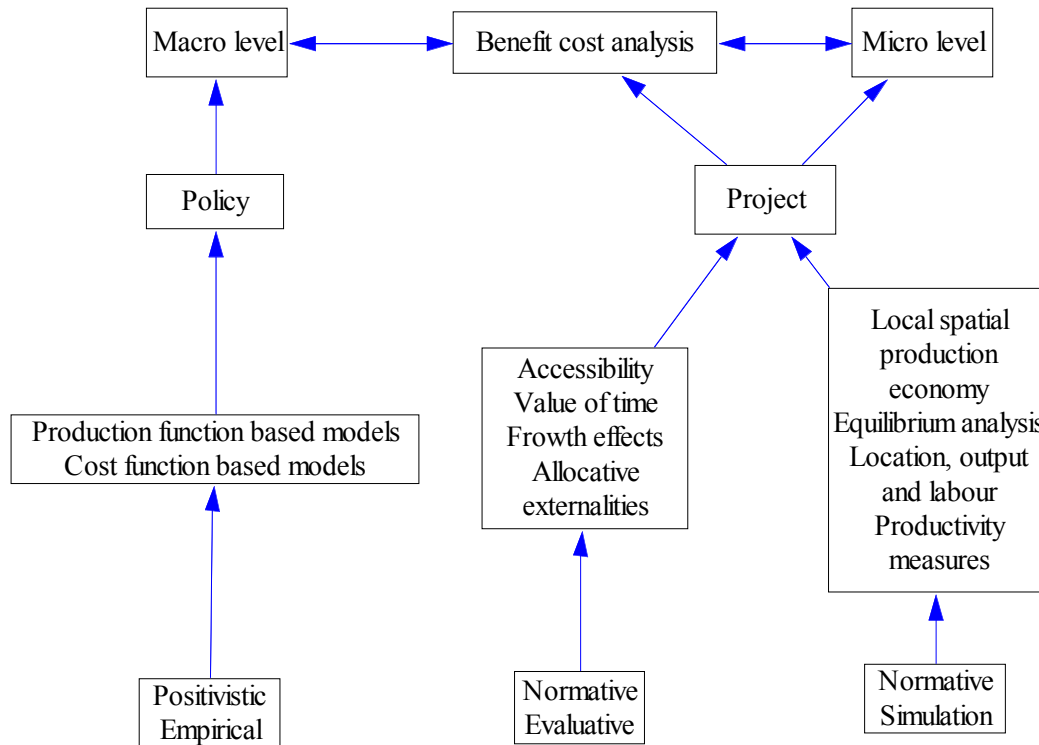


Figure 2: The complementarity of approaches (source: Banister and Berechman, 2000)

Chapter 6 - Modeling the growth effects of transport capital investments: a macro level analysis

This chapter tries to answer the following questions:

1. "Does the level of the infrastructure stock affect national or state economy growth?"
2. If it does what is the marginal contribution from additional investment in public capital on factor productivity?"

Two types of models are developed: production function and cost function models. The main assumptions for the building of the models are that:

- "Infrastructure capital expansions helps in the increase of efficiency and profitability of businesses
- The increase of efficiency of businesses stimulates investment in private capital."

The problems faced with the use of the above models are many. First, they perform statistical analysis. Second, they assume that the level of capital stock is already efficient and that growth can occur only with additional investment. Third, they also assume that investment in stock leads to greater output and that is questionable. Specifically for production function models, they omit input prices and place restrictions. The conclusion is that while using such models, attention should be made for misspecifications that might occur.

Chapter 7 - Economic evaluation of transportation projects

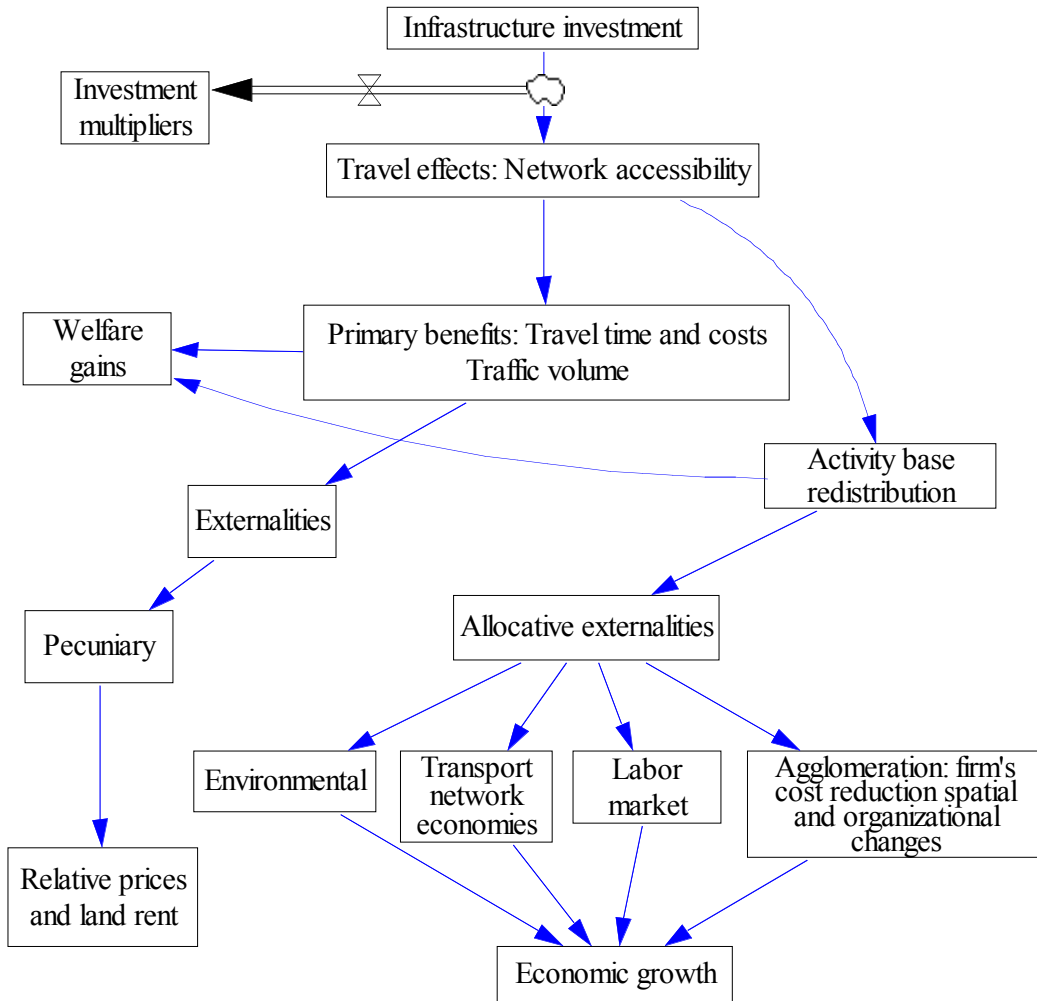


Figure 3: The scheme of evaluating economic growth benefits from infrastructure investments by Banister and Berechman (source: Banister and Berechman, 2000)

The most common approaches of evaluation are Net Present Value (NPV) and Internal Rate of Return (IRR). The benefit cost analysis is also widely used. A classification of available methods follows:

1. "Benefit cost comparisons
 - a. Cost-effectiveness analysis (CEA)
 - b. Benefit-cost ratios
 - c. Benefit-cost analysis (BCA)
 - d. Risk-benefit analysis
2. Multi-criteria analysis (MCA)

This kind of analysis includes a series of methods that are designed for particular application
3. Impact statements (IS)
 - a. Social impact statement
 - b. Environmental impact statement
4. Others
 - a. Total cost analysis
 - b. Full costs and benefits analysis
 - c. Project's life cycle analysis"

Author: Banister, D. and Berechman, Y. (2001)
Title: Transport investment and the promotion of economic growth.
Journal of Transport Geography, 9, pp. 209-218.

Summary:

The paper addresses the key question of “whether transport infrastructure investments” in general promote economic growth at the urban and regional level in developed countries. The concern of the paper is the impact of measuring these benefits on the transport investment decisions mainly and fear to implement the wrong project due to erroneous or double counting of these benefits.

- Conceptual issues underlined in the paper are: additionality and measurability of the assumed benefits:
 - (1) whether transport investment brings any additional economic development benefits besides the obvious travel time reductions, and if so, how they can be measured;
 - (2) wrong measurements would result in double counting of benefits and risking implementation of wrong projects.
- The most commonly used method to evaluate transport projects is cost benefit analysis
- Transport investment is not a necessary condition for economic development – “but it acts in a supporting role when *other condition* are at work”:
 - (1) presence of “underlying positive *economic externalities*” such as agglomeration and labor market economies, good quality highly skilled labor force, etc.
 - (2) *investment factors* such as the availability of funds for the investment, network effects (e.g., missing links in the network, etc.), timing of the investment
 - (3) *political factors* – broader policy environment within which transport decisions are made, i.e. to achieve economic development there must be a policy environment in place that enables facilitation of decisions to avoid counterproductivity. These include the sources of finance, level of investment at local, regional and national levels, legal and institutional policies and processes.
- Neither of these factors on their own cannot result in economic growth, unless all others are also in place.
- Combination of either two conditions would lead to the accessibility changes and redistribution of existing economic development only at best but not to additional development benefits.

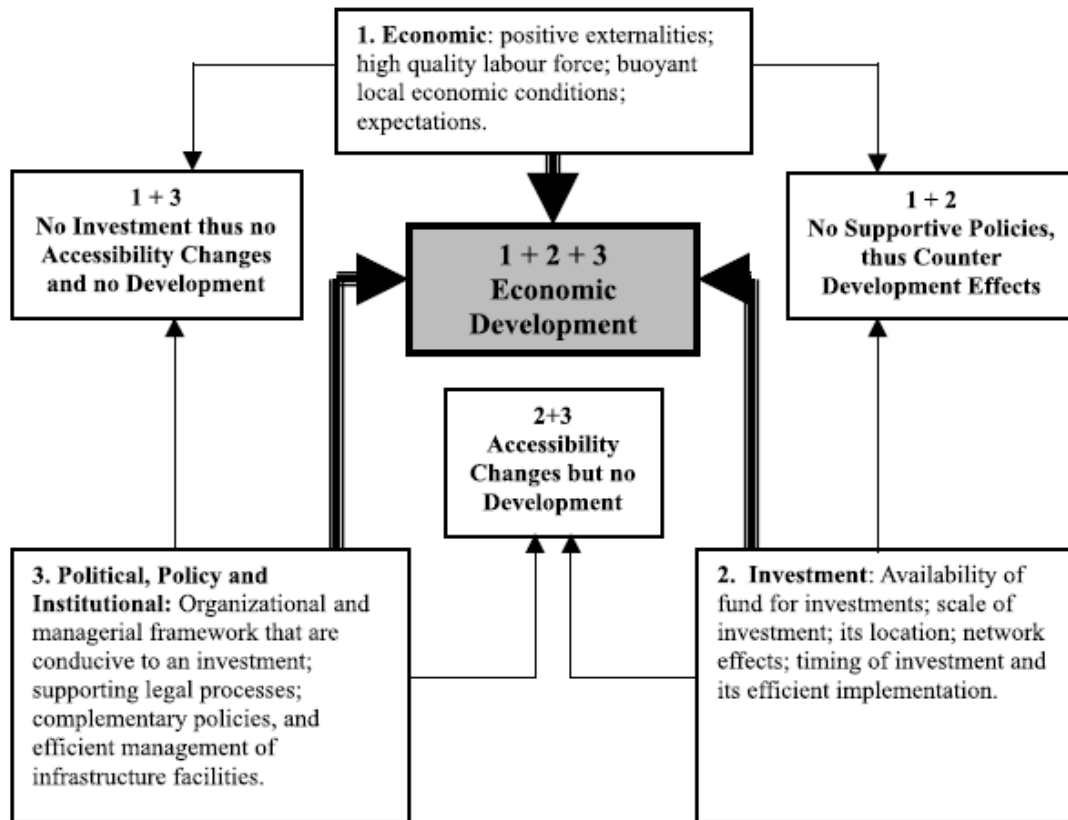


Figure 4: Illustration of the necessary sets of conditions (source: Berechman and Banister, 2001)

- Transport investments are location specific and have potential growth effects on local economies – hence, the analysis has to take place at the local level to assess (more aggregate analysis, many of the impacts are lost), but at the same not be concerned with user benefits (travel-time savings) – need much wider assessment of costs and benefits at the local level:
 - Impacts on income levels
 - Accessibility
 - Employment
- Key question and answers based on the literature of transport and economic development have been answered.
- *Methodological framework* adopted by Banister and Berechman has three dimensions:
 - Scale of analysis: national, regional and local
 - Variable types for assessing the investment and its impacts (see Table 1)
 - *Time duration of effects*

Variables	Scale of analysis		
	National	Regional	Local
Economic development measures	Productivity growth; social rate of return	Accessibility changes; changes in the location of retail, housing and employment activities	Employment level; time allocation; labour productivity
Output measures of models	Annual GDP growth	Spatial relocation; competitive advantage; industrial clustering	Growth in jobs; welfare improvement; agglomeration economies
Scale and type of transport investment	Total state capital; infrastructure stock	High-speed regional rail and road networks; regional terminals; airports; seaports, waterways; pipelines	Metropolitan roads and facilities; new rail links; underground rail; transport centres

Table 1: Conceptual framework of analysis (source: Banister and Berechman, 2001)

- *Decoupling transport from economic growth:*
 - Causality mechanism underlying the relationship – does transport investment promote economic growth or does growth encourage more demand for transport and thus further investment.
- *Complexity and causality:*
 - For transport-induced economic growth to transpire – various economies need to be present in various markets, the principal ones being *firms' agglomeration, transport network, labor market, land market and environmental quality enhancement*. Merely improving accessibility (which translates into travel time and higher travel volumes) is not sufficient to generate growth.
 - *Causality*: doubtful that public infrastructure investment will lead to substantial increases in new employment (potential savings will be realized through increased productivity of existing labor force).
 - Changes in accessibility may induce relocation – which may induce further growth but only if these changes are above threshold and other factors are at work strongly.
- *Accessibility and proximity:*
 - Infrastructure investment enhances accessibility, which in turn provides *engine for potential increases in economic activity* realized mainly through *employment and productivity increases*. However, empirical evidence is mixed on this argument.
 - *Accessibility* is relative concept: may help one location but at the expense of a competing location.
 - In most advanced countries levels of *accessibility are already high (highway in place already in Portugal)* – so the effect on the system as a whole may be marginal. It also usually enhances the existing trends rather than creating new ones.
 - *Proximity* – while proximity leads to development, it may also have a conflicting effect - in a well-connected society there may be non-proximity or diseconomies of

agglomeration. Since many services can be provided remotely such as in IT services, proximity is not important. In fact, high tech communications and transport infrastructure facility have allowed the firms to have greater flexibility in the location (where labor is cheaper).

- *Economies of scale and of agglomeration* are important – as locations that have specialization tendencies may benefit from reduction in transport costs.
 - Krugman (1991) brings up an example of when a reduction in transport costs from transport improvement investments affect the manufacturing location of production – high transport costs disperse the locations (core and periphery) and fall in transport costs shifts the production into one location (core or periphery).
- *Policy design* has a crucial role in influencing and strengthening potential impact of transport investment on local economic development.
 - Policy making is critical factor in realizing economic growth benefits from transport investments

* * * *

Authors: Bruinsma, F. and Rietveld, P. (1993)

Title: Urban Agglomeration in European Infrastructure Networks.
Urban Studies, Vol. 30, No. 6, pp. 919-934.

Summary:

Bruinsma and Rietveld demonstrate the belief that transportation infrastructure constitutes an “economic determinant” of urban agglomeration. Thus, they study the positioning of 42 European cities according to the rail, air, and road networks that they have. The methodology used is the formulation of a *simple gravity model*, with travel time being the main parameter, which measures the accessibility of each. First, the model is applied to air traffic then to rail and then to road. According to the ranking of the cities, suggestions are made for the improvement of the existing networks. Specifically for the rail network, a discussion of the scenario of HSR in the European Union is presented. Moreover, they study the aspect of the national borders as barriers to the road network.

One of the main conclusions is that rail inaccessibility is the highest and road inaccessibility the lowest. Also, it is realized that the impacts of HSR will be greater regarding the issue of accessibility, in comparison to road and air improvements. Lastly, it is realized that the national borders will mostly serve as obstacles to agglomeration to smaller countries. Thus the European Commission should consider this when deciding the transportation policies of the Union.

* * * *

Author: Cambridge Systematics Inc. and Reilly, M. (2007).
Title: Economic Growth Effects Analysis for the Bay Area to Central Valley Program – Level Environmental Impact Statement Report and Tier 1 Environmental Impact Statement. Final report. Retrieved from http://www.edrgroup.com/pdf/economic_growth_effects_complete_new.pdf

Summary:

The results of this report are developed with the use of a software program called Transportation Economic Development Impact System (TREDIS). This software enables the economic development impact evaluation and benefit-cost analysis for a transportation investment (applicable for all modes). It can also be used for examining different scenarios. The process considered the effects that change travel options, congestion and delay between existing conditions and future years would have in the State's economic growth. They also modeled several dimensions of growth and spatial re-allocation that could occur with any of the system alternatives and considered many possible impacts of HSR on jobs, population and land development.

* * * *

Authors: Elhorst, J.P. and Oosterhaven, J. (2003)
Title: Effects of Transport Improvement on Commuting and Residential Choice
43rd European Congress of the Regional Science Association. August 27-30, Jyvaskyla. Retrieved from <http://www-sre.wu-wien.ac.at/ersa/ersaconfs/ersa03/cdrom/papers/29.pdf>

Summary:

Elhorst and Oostehaven are developing a *commuter location model*. Their model has been created to simulate residential location changes of commuters that are affected by transport improvements. Their results have an estimation error of 7%, justifying the accuracy of their model. Six high-speed rail connections between Amsterdam and Groningen were used to test the model. According to their literature review, there are three strands that deal with the issue of the reaction of households.

1. "Gravity and entropy models in which all individuals have a standard residential location
2. Urban economic models which assume that workers choose their residency according to the maximization of their utility by trading off commuting and housing costs
3. Models that elaborate on urban economic models"

While developing an assignment model, their objective is to predict at best accuracy for the actual spatial distribution of the working population.

Data needed

1. "Number of jobs per employment zone
2. Commuting times
3. Zoning pattern and variance in travel times
4. Number of modes
5. Residential attractiveness
6. Empty time classes: those occur when an employment zone is isolated from other zones"

Assumptions made

"All municipalities studied have the same commuting time distribution"

This model is suggested to be used for any transportation improvement both in the private and public sectors. It is not so data-intensive, thus can be used more easily than other models in which the database needed might not always be available.

* * * * *

Author: Givoni, M. (2006)

Title: Development and Impact of the Modern High-speed Train: A Review.
Transport Reviews, Vol. 26, No. 5, 593-611, September.

Summary:

Givoni is concerned with the different elements of High Speed Train operation, the impacts delivered from its design, and what it can deliver. In the beginning a review of the main high speed train technologies is presented (the Shinkansen, the TGV, the tilting HST and the Maglev HST). The following benefits are recognized for High Speed Trains as modes:

1. "Increase of capacity

2. Travel time reduction and increase of service that changes the mode shares and generates new demand. Diverted passengers are mostly coming from the air share and not from the car share.
3. Ability of achieving very high operating speeds (above 120km/h)
4. Dense and dominant cities are mostly attracted to HST''

Great emphasis is given to the fact that HST constitutes a great substitute to airplanes. This is because of the competitive travel times it offers due to the station placement in the city centers (ex. Paris-Lyon where there is no air connection). The previous assumption holds for specific distances (up to 1000km at maximum) and when there are direct connections. Moreover, there are situations in which high-speed trains constitute complements to aircraft rather than substituting for them (ex. "London-Paris where 70% of the market is captured in HST but there are still about 60 flights a day that connect the two cities"). On the contrary, when HST is introduced by large airports, then they do substitute for air travel.

Other impacts are also possible to observe when HST are applied, and those are spatial and socio-economic impacts. The shorter travel times offered bring cities closer and also improve the level of their connectivity and can lead to economic growth. This is not a rule, because there are regions whose economic situation led to drainage of economic activities after HST were implemented. Furthermore, new stations are built and existing ones are expanded. There are cases in which the above alternations were positive to the development of the surrounding areas and others in which nothing different happened. In conclusion, although there is a strong determination that HST will have positive economic impacts, there is no evidence that this is definite.

As far as the environmental impact of HST is concerned, it is believed that it is the most environmental friendly mode and especially compared to airplanes. However, the operations related with HST have negative impacts on air pollution, climate change, noise, and land-take. Sulfur dioxide (SO₂) and nitrogen dioxide (NO_x) are considered to be the most harmful pollutants produced by HST.

The cost of infrastructure varies greatly depending on the country where it is constructed. The reason for variation is due to the different terrain along the route, which determines the number of bridges or viaducts and tunnels (works that increase the cost significantly) that are needed. In addition, the cost is affected by the general economic characteristics that determine the cost of land and labor.

The main conclusion is that HST can result in positive socio-economic benefits but not always.

Authors: Iacono, M. and Levinson, D. (2008)

Title: Review of Methods for Estimating the Economic Impact of Transportation Investments. Retrieved from <http://nexus.umn.edu/Papers/EstimatingEconomicImpact.pdf>

Summary:

There is a variety of ways, methods, models and tools to estimate the economic impact of transportation improvement. Thus, Iacono and Levinson present such methods with particular interest focused on those that use projects that add highway capacity in urban areas.

The issues that exist with the economic impact of transportation improvements are two. One is the issue of geographical scale studied, and the other is that there are many parameters to be assessed, like travel time reductions, more efficient supply chains and others. Project-level studies are mostly focused on price of land, whereas more aggregate methods are applied to property and product issues.

- Software tools for impact analysis
 - “MicroBENCOST is a sketch planning tool that estimates basic benefits and costs for highway improvement projects and capacity additions.
 - Sketch Planning Analysis Spreadsheet Model (SPASM) is a benefit-cost model designed for “screening level” analysis. The outputs are project costs, cost-effectiveness, benefits and energy and air quality impacts. It also allows the comparison of multiple modes and non-modal alternatives.
 - The Surface Transportation Efficiency Analysis Model (STEAM) is a planning-level extension of the SPASM software, which helps to design a fuller evaluation of cross-modal and demand management policies.
 - The Spreadsheet Model for Induced Travel Estimation (SMITE) is a sketch planning application which works with STEAM in order to account the effects of induced travel in traffic forecasting.
 - SCReening for ITS (SCRITS) is a sketch planning tool used for rough estimates of ITS benefits.
 - Highway Economic Requirements System for states (HERS-ST) is a model for economic impact evaluation of highway improvements.
 - Those software tools are unable to capture the full range of impacts of new highway capacity projects in particular. As far as benefit-cost analysis is concerned, it is necessary to make simplifying assumptions in order to apply them. This simplification involves uncertainty and risk. Thus, [the] UK and many other European countries have changed into using multi-criteria approaches where economic development is one of the result components. Other serious issues are also captured such as environmental, equity and safety.
- Aggregate economic and econometric methods are exploring economic impacts at a larger scale.
- Regional economic models are used to measure the effects at a regional level. Those apply macroeconomic simulation modeling methods to measure cost savings and

productivity enhancement. Such regional input-output models are IMPLAN, RIMS II and REMI (Regional Economic Model, Inc.).

- Aggregate production functions
- Cliometric methods (after the Clio muse from the Greek mythology)
- Disaggregate economic and econometric methods
 - Disaggregate economic models that relate levels of highway capital spending to economic parameters like employment and income.
 - Hedonic models for property valuation which capture the property value associated with infrastructure accessibility”

The main conclusion is that, although there is a variety of methods and models to be used, none of them should be used by itself, since all of them lack the ability to model all the effects of upgraded facilities. Thus, the solution is to choose, compare, and combine one or more of the above methods according to the nature of the project that is desired to be evaluated.

* * * * *

Author: Lynch, T. (2000)

Title Analyzing the Economic Impact of Transportation Projects using RIMS II, IMPLAN and REMI.

Prepared for Office of Research and Special Programs U. S. Department of Transportation, Washington D. C. Retrieved from http://dlis.dos.state.fl.us/bld/roi/workshop/handouts/roi_workshop_lynch_report.pdf

Summary:

It is of great importance to perform the economic analysis of the impacts of transportation projects in order to decide on their implementation. For that purpose, the most used software use the input-output models. These are models that can capture the “direct, secondary indirect and induced effects”. “They account for inter-industry relationships within regions, since they produce input-output (I-O) multipliers”. In this paper three such models are presented.

1. Regional Input-Output Modeling System (RIMS II)

This model was developed by the U.S. Department of Commerce and is the cheapest. It is used both for public and private sector projects and at all levels of analysis (national, state and local). For each industry, “an I-O table shows the industrial distribution of

inputs purchased and outputs sold". The advantages of this model are that multipliers can be estimated for any region and that their cost is relatively low. As far as its accuracy is concerned, it has been proved that the results produced do not have great differences in magnitude from the results of expensive surveys. Moreover, the model helps to avoid "aggregate errors" and also has the ability of comparing results across areas. Lastly, multipliers are consistently updated in order to reflect the most recent local-area wage and salary and personal income data. The data input are industry category, year of expenditure, location, and the output given are earnings, output (change in the dollar value of production), and jobs.

2. IMPLAN

This model was developed by the Minnesota IMPLAN Group, Inc. IMPLAN is not expensive and is more complex than RIMS II. The data in this model are "built from top to bottom". "National data serve as control totals to state data", which serve county data. The resources of employment and earnings data are County Business Patterns data and U.S. Bureau of Economic Analysis (BEA).

3. Regional Economic Modeling, Inc (REMI)

REMI is the most sophisticated and expensive model of the three. It is an integrated output-econometric model developed by Regional Economic Modeling, Inc. One can say that this model is more than an econometric model. It is a tool that combines an input-output model with an econometric model, and whenever the second is suppressed then REMI downgrades to an I-O model. The description of the model is highly complex. One needs to know that it consists of five basic blocks:

- "Output
- Labor and capital demands
- Population and labor supply
- Wages, prices and profits
- Market shares"

As far as input data is concerned, employment, income and output data is of greater importance. The sources that this model uses are BEA ES-2 and County Business Patterns data published by the Bureau of the Census.

* * * *

Author: Oster, C., Rabin, B. and Strong S. (1997)
Title: Economic impacts of transportation investments: the case of Federal Express.
Transportation Journal, Vol.37, No. 2, Winter 1997, p.34-44.

Summary:

Oster et al. are concerned with the estimation of the economic benefits of an air cargo hub facility on the local economy. They are using and comparing methods of estimation; one is a *static input-output model (RIMS II)* and the other is an *econometric technique*. They are doing so, because the first cannot capture the effects that arise from business location decision, whereas the second can. In their study, the application is being used for four local Midwestern economies (Indianapolis, Cincinnati, Louisville and Memphis).

RIMS II is widely used for the estimation of economic impacts of transportation investments. It is a model that can measure the effect of a change in a regional economy. It has the ability of recognizing that the outputs of an industry might be the inputs of another and also that the wages of employers are spent on goods that are produced from a variety of industries. All input-output models are developing multipliers, a convenient way of capturing secondary effects throughout the economy. Data can be collected on the national and regional level in order to input in the model. Moreover, the analysis can be performed on all levels of country, state, county and region, since all kinds of multipliers can be produced by the model. Also, a variety of multipliers can be developed for all industries individually or in an aggregated manner.

The advantages of multipliers development are as follows:

- “Available nation-wide so can be used for comparison of different regional economies
- They are available at a low cost”

Disadvantages of RIMS II model:

- “No estimation of the duration of the effects
- The aggregation of industries limits precision
- There are dimensions of the economy that cannot be examined
- Incapable of capturing effects of substantive changes that result in structural shifts of the regional economy”

The econometric model was used in order to “capture the effect of employment changes in the air industry of the regional economy to the total employment of the region”. Economic development impacts from transportation infrastructure investments are highly complex, and the development of a model that captures the interaction is not easy. The data needed need to come from reliable sources. For the purpose of this study, data were taken from the Bureau of the Census County Business Patterns data series for all the metropolitan areas for the period

1977-1990. In the equations tested, the dependent variable was the change in total regional employment. All variables, both dependent and independent, were estimated as changes occurred in the prior year. The reason for estimating changes was because the change of transportation employment was of main interest and also to overcome technical econometric problem related to the use of time series data. The factors captured in the model were the following:

1. "Change of employment in the transportation sector
2. Change of employment in manufacturing
3. Change in Gross National Product
4. Change in personal income in the region
5. Change in National Unemployment Rate"

* * * * *

Author: Pickton, T., Clements, J. and Felsburg, R. (2007)
Title: Statewide Economic Benefits of Transportation Investment.
Report No. CDOT-2007-5. Final Report.

Summary:

Colorado Department of Transportation (CDOT) did research on exploring the economic benefits of transportation investments and formed the Economic Benefits Research Scoping Study. After that, CDOT asked from BBC Research and Consulting (BBC - an economics research firm) and Felsburg Holt & Ullevig (FHU - a transportation engineering firm) to estimate the economic benefits of different transportation investment scenarios in order to understand the link between transportation investment and economic growth. The objectives of the study were to estimate the statewide economic benefits and also to identify the data needed for studies to be performed in the future. The steps followed were the following:

1. "Set baseline and alternative investment scenarios
Two levels of investment were identified. One consistent with current revenue forecasts ("Forecast revenue") and one higher level of investment that would maintain current system performance ("Sustain current performance").
2. Evaluate benefits
3. Incorporate a vision for the future"

The benefits were divided into those which can be quantified and those that cannot be quantified.

- "Quantifiable benefits

- Travel time savings
- Reduced vehicle operating costs
- Reduced congestion
- Better pavement quality
- Safety condition improvements
- General system improvements
- Shorter travel times
- Reduced vehicle operating costs
- Fewer accidents and injuries
- Business expansion and attraction
- Air quality changes
- Non-quantifiable benefits
 - Economic competitiveness
 - Increased access to labor and other inputs
 - Expanded market reach
 - Depends on level of investments in other states
 - Benefits to tourism (finding from the I-70 Programmatic Environmental Impact Statement)
 - Increased visitor days
 - Increased out-of-state visitor spending
 - Quality of life
 - Local air quality improvements
 - Access to jobs and services
 - Improved public transportation in metropolitan areas
 - Increased leisure time
 - Short-term construction benefits
 - Efficient transportation investment
- Benefits of the 2030 vision
 - Improved safety
 - Economic development
 - Public transport demand increase resulting from improved transit system
 - Access to recreation destinations”

The four figures that follow depict the methodology that was followed for the estimation of benefits on each category.

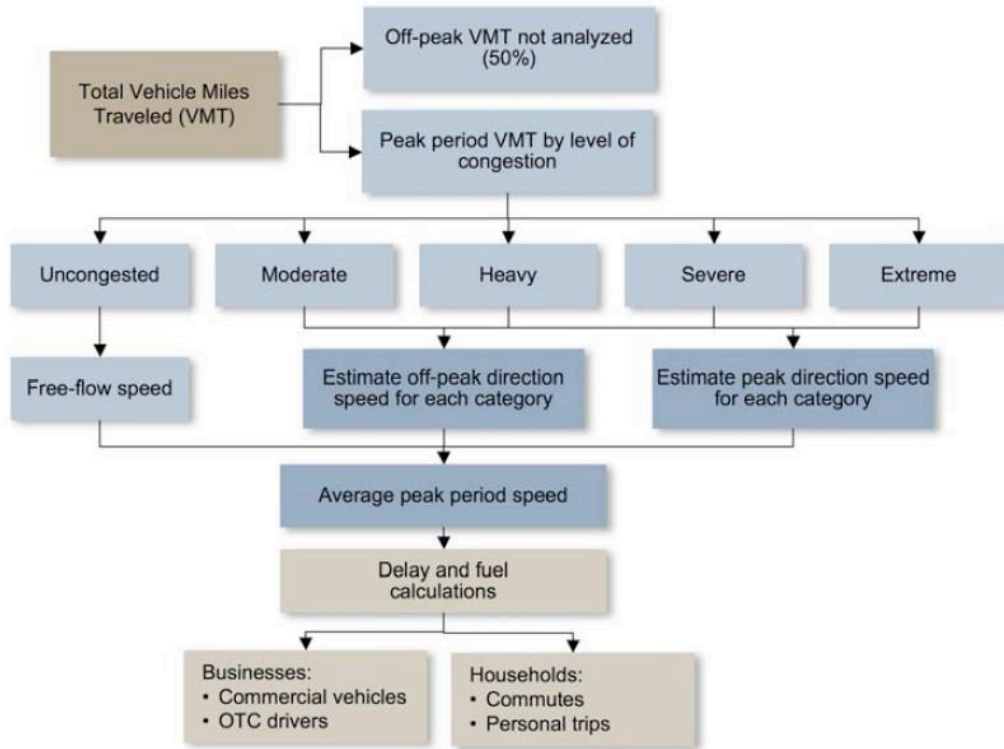


Figure 5: Methodology for estimating travel time savings (source: Pickton et al, 2007)

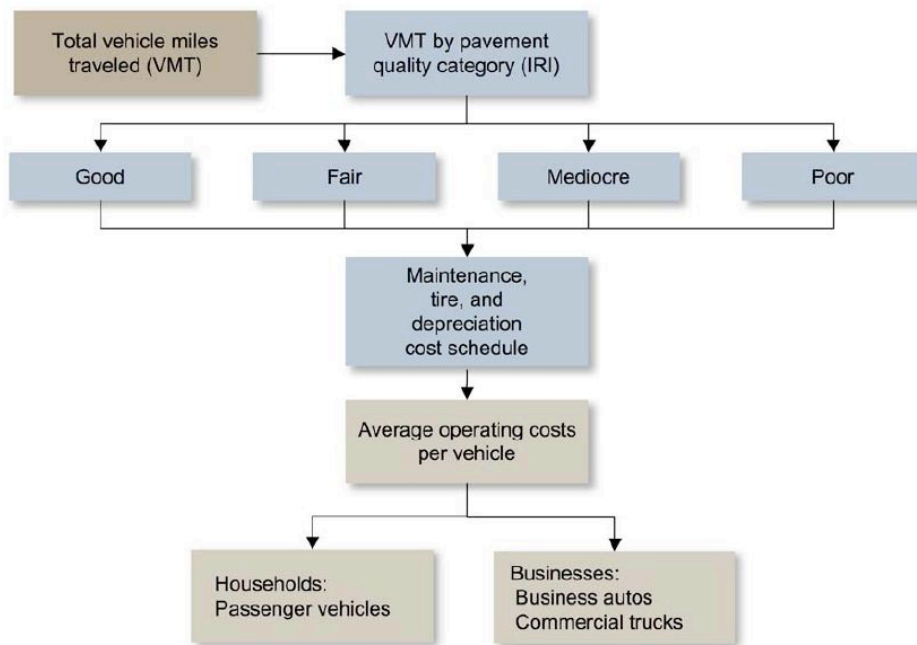


Figure 6: Methodology for estimating reduced vehicle operating costs (source: Pickton et al, 2007)

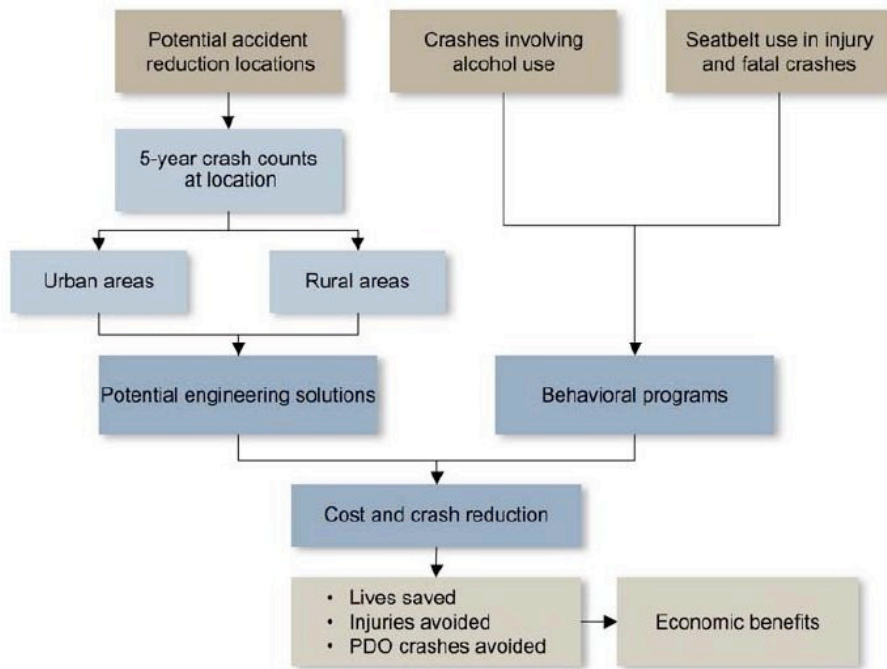


Figure 7: Methodology for estimating safety effects (source: Pickton et al, 2007)

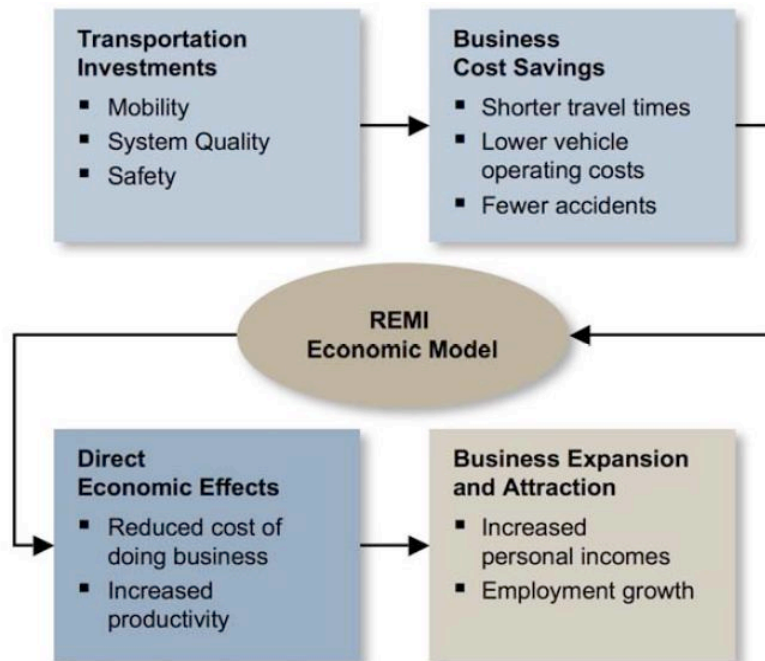


Figure 8: Methodology for estimating the macroeconomic benefits (source: Pickton et al, 2007)

In the conclusion, it is emphasized that several data limitations constrained the study. It is suggested that a more in-depth analysis requires local data, enhanced traffic, economic modeling capabilities and additional specific information on the local level, original-destination patterns of trucks and commercial vehicles, changes in vehicle miles traveled, more detailed economic data of regions and timing costs and benefits.

* * * *

Author: Puga, D. (2001)

Title: European Regional Policies in Light of Recent Location Theories.
Discussion Paper Series No. 2767, Center for Economic Policy Research, London,
UK

Summary:

The goal of European regional policies is to reduce *regional inequalities*. However, regional inequalities in Europe have not narrowed down in the recent years, but on the contrary, have widened in some cases. "Most regional income inequalities in Europe are within" States, and not across the States ("income inequalities across EU States have fallen by 25%", while those within a Member State have increased by 10%).

- Based on observations, the firms produce more efficiently and workers receive greater wages or welfare in locations close to large markets. In turn, large markets are located where "more firms and workers locate".

The paper discusses that the new *economic geography models* or "*location theories*" can help to explain how "regional inequalities" evolved "during a process of economic integration" in the EU. They help to understand the "relationship between transport costs, agglomeration, and regional inequalities" and to reconsider the role of EU's regional policies, especially regarding transport infrastructure improvements.

- Traditional economic theories explain "differences in production structures mainly through differences in characteristics such as natural resources, production factors, infrastructure or technology", i.e. that "integration leads regions specialize according to their comparative advantage". However, comparative advantage theory does not explain the uneven "spatial concentration of activity" across regions/areas with very similar characteristics.
- The theoretical trade models formalized by Krugman and Venables (1990), Krugman (1991) and Puga (1999) explain the relationship between trade costs and the location of industry, labor mobility, productivity levels and unemployment rate.

- “The lack of interregional labor mobility can make the relationship between regional integration and industrial agglomeration non-monotonic, so close enough integration can trigger the industrial take-off of less developed regions.”
- “Reductions in trade or transport costs, by affecting the balance between dispersion and agglomeration forces, can decisively affect the spatial location of economic activities.”

EU’s regional policies have been targeting to reduce regional disparities and one of its major instruments has been the improvements in transport infrastructure.

- Economic evaluations of projects normally consider the impacts of transport infrastructure improvement on the regions such as reduction in cost and increase in the quality of transport links, induced trips and the mode split, and environmental impact.
- However, there is an *ambiguity* in whether lower transport costs facilitate convergence of regional inequalities. On one hand, a better connection between a developed region and a less developed one allows the firms in a less developed region to have better access to the inputs and markets of a more developed region. On the other hand, the firms in richer regions can easier “supply poorer regions at a distance” and therefore “harm the industrialization prospects of less developed areas”. For example, Faini (1983) argued that “the reduction in transport costs between Northern and Southern Italy in the 1950s” led to acceleration of “deindustrialization process in Southern Italy” because the firms lost the protection.
- The economic geography models explains this ambiguity by pointing out that the overall economic effect of transport infrastructure improvement on less developed regions depends not only on lower transport costs but also on other economic factors “such as mobility and wage rigidities” and on “characteristics of the transport project”. For example, with little interregional migration and no wage variability between the regions, transport infrastructure investments “can do little to help poorer regions catch up, and may even widen their lag with respect to richer regions,” even when there are vast differences in their attractiveness to firms.
- According to these models, the Trans-European Transport Network planned as part of EU’s policies for reducing regional inequalities, will provide better access for the rest of the EU to the existing activity centers and reinforce “the position of current core regions as transport hubs”. This will consequently increase the gap in relative accessibility between the core and peripheries.
- Roads have more impact on spatial allocation of production and regional inequalities as it is more used for freight shipments, while HSR is not.
- EU’s policies have shifted their emphasis in transport infrastructure investments from roads to high-speed rail.

Impact of *High-speed rail* in the context of location theories is:

- Since HSR usually is not suitable for transporting the freight, it is thus “unlikely to have much effect on the location of industry,” but “may have larger effects on the location of business services and headquarters.”
- “The resulting increase in the opportunity to provide business and headquarter services to remote locations may lead to the concentration of business services and headquarters in a few large cities.” Some evidence exists that the HSR link between Paris-Lyon “led to relocation of headquarters from Lyon to Paris. Spain is also concerned that “the Madrid-Barcelona high-speed rail line may reinforce the process of headquarters relocation towards the capital.”
- HSR favors the existing cores (centers of activity), which will be the main nodes of the network, and “is unlikely to promote development of new activity centers in minor nodes or in locations in between nodes.” This can be explained by two distinguishing characteristics of HSR: “its strong nodal aspect” as with too many stops HSR is not longer high-speed and its “large sunk costs relative to operating costs.” The places located between the main HSR nodes are unattractive locations for production, and “the increasing returns to scale” exhibited by HSR technologies “are unlikely to promote new centers of production even on nodes of the network.”

B. Studies of Economic Development Effects of HSR on Local and Urban Levels

Authors: Bruinsma, F., Pels, E., Priemus, H., Rietveld, P. and Van Wee, B. (2008)

Title: *Railway Development – Impacts on Urban Dynamics.*
Physica-Verlag, Heidelberg

Summary:

Chapter 2: Urban dynamics and transport infrastructure – towards greater synergy. *Priemus, Hugo*

Priemus is concerned with the “synergy between urban development and the development of transportation networks in Europe” and what is the role of various policies in this. The hypothesis is that this relationship has weakened since cars and airplanes have been widely preferred. Typical examples of good synergy are monocentric cities like London and Paris, where the metro system is extensively developed and ease the access to downtown. This relationship can be reinforced in European cities with the development of the HSR network. First, the areas where the stations are and are going to be built will cope with an increased flow of passengers, thus increasing the purchasing power of the area.

Chapter 3: Station areas as nodes and places in urban networks – an analytical tool and alternative development strategies. *Bertolini, Luca*

Transport innovation triggers new development in the station area. Station areas constitute both ‘nodes’ and ‘places’ in both transport and non-transport networks. They constitute a “dense and diverse conglomeration of uses” and the dynamic that is developed is really important. The increase of accessibility creates favorable conditions for further development. The strategy formed for the paths and station locations is critical to development.

Chapter 4: HSR stations and urban dynamics – experiences from four European cities. *Pol, Peter*

This paper discusses about “two type of cities; Cities in Transition (CiTs) and International Service Cities (ISCs)”. The former are old cities that need to “diversify” their economy in order to “attract new businesses”. The latter are cities like London and Paris that are really competitive and already attractive with high levels of accessibility. HSR can contribute in the expansion of relevant regions of cities because distances are “shortened” by faster transport. This advantage attracts firms and residents to the proximity of the stations, thus increasing the status of the location. HSR “can affect the regional economy in two ways”; either by constituting “the catalyst or by having a facilitating role”. The first occurs when “new activities” are

attracted, whereas the second occurs in already developed areas that need more investment to “accommodate their growth”.

Chapter 8: Ex ante evaluation of railway station development projects – issues still to be solved. *Rietveld, Piet*

The most widely used method for ex-ante evaluation of railway system investments has been the Cost-Benefit Analysis (CBA) and “to a lesser extent” the Multi-Criteria Analysis (MCA). The CBA evaluates benefits on travel-time savings, induced demand and environmental impacts. The impact of the railway stations as nodes (the value of the position of the station to the network), and places (link between the station and the surrounding area) is also very important and analysis has been done on this topic by Bertolini and Spit.

Generally speaking, CBA is a method that illustrates the positive and negative impacts of a project. These impacts are quantified in monetary values whenever possible. Because costs and benefits occur in a different time from when CBA is carried out, the values are presented in Net Present Values. The main results that are used for judging the value of a project are the difference between cost and benefits, the return on investment and the benefit-cost ratio. It is a popular method for several reasons.

“Investment, maintenance and operations costs” can be easily found from data on analysis of previous similar projects. For “travel time savings”, it is not difficult to compare the times with and without the implication of the transport investment. Models are used to forecast demand of passengers and volumes of freight. Also, the Value Of Time for expressing “the value of shorter travel times” into monetary values is very useful. “VOT differs according to modes, “income classes and other characteristics of travel and travelers”. Last, one can say that it is more ‘neutral’ compared to its main competitor MCA.

Travel-time savings are not fully expressed in GDP in CBA, and that because there are situations that do not affect the GDP like when a commuter leaves from home to work later than usual since travel times have been reduced. CBA approaches welfare in such a way that all benefits for consumers are included. Also, it calculates the induced demand benefits that also affect the consumer surplus. Benefits that refer to the company operating service, the environment and safety are also estimated with CBA.

The spatial and temporal boundaries are of great importance for CBA. Spatial boundaries should not be that tight, since impacts might occur outside the area of study. To continue, the opening year is very important, because after that benefits will occur and also the time horizon should be long (20-30 years), because there are some long-term benefits that need time to be realized. Another advantage of CBA is that it can take into consideration long-run adjustments of employment in terms of work and residential location and of services.

The Dutch transport advisory Council for Transport and Public Works has categorized the several benefits of public transport into the following:

1. "Spatial and economic development
2. Possibilities to participate in activities
3. Livability in central urban areas
4. Safety
5. Stimulation of innovation of market places"

Unfortunately some of the above benefits are not fully or covered by CBA at all. This paper discusses the abilities of CBA for evaluating the "surplus equivalence issue", the relationship between "transport cost" changes and "land prices", the experiential benefits of the project, and the result is that CBA cannot capture them. It seems that CBA performs well when used for policy decisions. The final suggestion is to use CBA with MCA in order to include as many benefits as possible in the ex-ante evaluation.

Chapter 9: Multicriteria analysis of a high speed railway station area development project.

Vreeker, Ron

"Multicriteria decision analysis is a family of methods" that includes more than 100 ways of evaluating projects. They are mostly used for deciding from a variety of alternatives. Their categorization can be carried out according to the type of alternatives they address, their data capabilities or the decision problem they are addressing. In general, they use a set of criteria with a set of weights in order to reflect the preferences of the decision-maker. There are three types of aggregation procedures: iterative, complete, and partial agglomeration. The iterative procedure has the advantage of choosing the most efficient from an infinite set of alternatives. When speaking about HSR, the number of alternatives is discrete and restricted, so the use of iterative methods is not appropriate.

In this kind of analysis (MCDA), it is assumed that the decision-maker structures his/her preferences between indifferent and preferential relationships, which are transitive. One of the theories based on this assumption is the Multiple Attribute Utility Theory (MAUT), which has been "used widely for economic and financial problems". MAUT is based on the assumption of utility maximization and applications have shown that the results produced are "well-defined" and easily explained.

Criticism of MAUT has led to the development of the "Multiple Criteria Decision Aid", which focuses on learning about the problem and produces an acceptable solution. The models derived from this school are structured by means of "preference, indifference, weak preference, and incomparability relationships", which are possibly intransitive. Other methods use pair-wise comparisons on each criterion in order to study which alternative is the most suitable.

To conclude, MCDA methods are used in order to include multiple views of the problem and evaluate the influence of multiple criteria. A long list of criteria and indicators can be formed so that the decision maker can choose which are relevant and to what extent (decide the weights on each indicator).

* * * *

Author: Sands, B. (1993)
Title: The Development Effects of High-Speed Rail Stations and Implications for California.
California HSR Series. Working Paper 566. University of CA at Berkeley.

Summary:

The paper examines the potential development effects of HSR system at the regional, urban and station level, with an emphasis of the latter, in California.

- The following changes are analyzed primarily: business behavior, real estate values, business and employment location, and residential location.
 - Other effects studied include changes in ridership, population and employment growth, overall economic activity and public sector activity affecting development.
- Based on the observed development effects of HSR stations in Japan, France and Germany, author outlines several potential development effects of HSR on CA. Development effects would be highly variable, depending on a range of factors, making it difficult to specify effects by location. General statements made are:
- Since paper was written during the recession times – it was prognosed to directly reduce the development effects of HSR, from regional to station levels.
 - HSR would increase population and employment growth rates in regions it serves above the statewide average. The regions that such a system would serve have been and will continue to be the fastest-growing in the state.
 - Jobs will increase the most in regions with large concentration of information related economic activities and centers of higher education (LA Basin and SF Bay Area).
 - Increases in employment and economic activity in the accommodation, retail and wholesale sectors would be dispersed across the whole system served by HSR, but with economic activity concentrations mainly in cities with stations.
 - Ridership would be low at stations without adequate transport network connections, specifically without urban rail link to the local city centers.

- Land value premiums of 20% might occur around stations given that adequate transportation infrastructure is provided and development is supported by public agencies.
- Recommendations based on experiences of Japan, France and Germany:
 - State agency responsible for HSR development must take a role of developing the areas around stations with a power to coordinate, facilitate, and provide support for property development around stations done by public agencies and private developers.
 - Same agency must work closely with local transportation authorities to ensure development of adequate modal connections to the HSR stations (accessibility to the stations and smooth transfers between modes). This may require provision of funding to local agencies to make these connections.
 - Stat of CA must purchase property for HSR lines and stations in order to be able to improve the development around the stations, ensure adequate linkages and capitalize on land value increases that the stations and related development will generate. Otherwise, the State may lose possible revenues to support the development of HSR facilities as well as lose ridership.

C. Studies of Economic Development Effects of HSR on Regional and National Levels

Author: Atkins Company (2004)
Title: High Speed Line Study – Final Report.
Department of Environment, Transport and the Regions. London.
Retrieved from
<http://www.dft.gov.uk/pgr/rail/researchtech/research/atkinshighspeed/milestone15.pdf>

Summary:

The Atkins Company, which was commissioned by the Strategic Rail Authority (SRA), carried out the feasibility study for the High Speed Line in the UK. This line was planned to traverse the country from the north to the south and would be dedicated to passengers only. The objectives of this study were to determine whether it would be realistic and defensible to construct HSL in the UK, who were going to be the potential stakeholders, how would those support this idea, and, finally, to design a forward plan. Many different aspects were investigated in order for the final suggestion to be fully supported. The following activities were carried out:

- “Option development and costing
- Demand modeling, forecasting and passenger surveys
- Economic analysis with the method of cost- benefit analysis and consideration of wider economic impacts
- Environmental assessment
- Financial modeling and project structuring advice
- Risk management
- Stakeholder consultation”

After reviewing the transportation statistics of the country, by performing a background study of the mode shares and the trends of the passengers travelling from north to south and vice versa, the base case scenario was studied. In this scenario, no upgrade in the existing rail line is included, only some other modernization construction. The forecasted demand of rail, highway, and air suggests that rail has to be expanded. Next, a review of the existing high speed rail line in Europe was performed and then the rationale behind the idea of HSL for UK was analyzed. The following criteria are taken into consideration for the formation of the HSL alternative:

1. “Environmental constraints and habitation
2. Synergy with land use and transport policy
3. Technical constraints and affordability

4. Stakeholder concerns
5. Different High Speed Line routes
6. Station access
7. Costs including construction, land acquisition, rolling stock purchase etc
8. Investigation of HSL capabilities from the time savings point of view"

Four other alternatives are also formed in order to be compared with the HSL option and those are:

1. "A new conventional rail line
2. Classic rail upgrades
3. Roads upgrade
4. Airport upgrade"

The transport case is then presented, where the impact on the different modes of the HSL is studied. The conclusion of the performed analysis is that HSL will attract passengers and also form diverted passengers, leading to the alleviation of the congestion problem on the roads of the major cities of the country. Moreover, it is believed that the number of diverted passengers will not affect the air market of the UK.

In addition, the appraisal of HSL under the schemes of the environment (landscape, heritage, biodiversity, water, noise and air quality), safety (forecast of accident reduction), economy, accessibility (service frequency, crowding effects, speed, and interchange) and integration with potential regional and national policies are held in order to fulfill the Government's key criteria of consideration for a transport mode. The conclusions of the above appraisal are:

1. "Safety on the transport network has the potential to be improved by HSL
2. There is an economic case for HSL with a cost-benefit ratio of at least 1.4 and the PPP scheme is required for delivering the system
3. Accessibility to the public transport network could be substantially widened by HSL
4. HSL has a reasonable level of integration with land use and transport policy
5. In environmental terms, it is difficult to construct a new railway without significant adverse impacts upon the natural and built environment"

The conclusion of the whole study is that the forecasted demand of north-south travel movements shows that the rail network needs to be expanded in order to serve the passengers and the socioeconomic studies performed support the idea of the HSL implementation.

Author: Atkins (2008)
Title: High Speed rail in the UK.
Written Submission. October 17.

Summary:

This is a written submission from Atkins consulting company to the UK Department for Transport (DfT) and Scottish Government who are responsible for setting overall railway strategy in the UK. The write-up provides a very brief overview of the HSR prospects in the UK, including the line extensions from England to Scotland, HSR technology and segregation of HSR from conventional rail, productivity benefits, mode shift, environment and fundability.

- Rail passenger traffic in general has grown in the UK faster than predicted mainly due to the following three factors:
 - Alternatives modes such as air and road have become more expensive and less convenient (higher security measures at airport and increasing car fuel costs);
 - The revival of major cities in Midlands, Northern England and Scotland moving “towards financial and professional/technical service industries” creates “greater propensity to use rail for business trips”;
 - “The quality of rail services in the UK has improved” and the benefits are being seen by the passengers.

- Currently there are two rail lines serving England and Scotland: “the East Coast and West Coast Main Lines”. The most advanced proposals for *HSR lines in the UK* are concentrated around the West Coast Main Line (WCML) corridor, “with a new alignment between London and Birmingham (West Coast Option), possibly extending to Manchester or Leeds. Another proposed route is between London and Leeds via the East Midlands (East Coast Option). Either of these routes could be extended to Glasgow and Edinburgh.”
 - West Coast Option is most likely to be funded as a first stage of a complete UK HSR network as it will improve travel times and capacity between a large number of major UK cities. But the case of extending the line beyond Manchester to Glasgow and Edinburgh is rather weak because “there are not major urban centers” for 200 miles of distance and the terrain is difficult.
 - Other issues to consider is the capacity of the new HSR line, as “the more cities are served by a single route,” the less capacity there is “available to serve the cities on the route.” *HSR would not be able to provide “similar capacity to all the cities served without significant reductions in train frequency.”*

- There is growing concern about the “*differentials in economic growth* between the North and the South of the UK and *how transport investment can assist in reducing the gap*”. The Crossrail scheme commitment is aimed to improve connectivity between London and the South East

in order to support economic development in East London. The main concern is “whether major improvements in journey times, either between London and Northern England and Scotland, or between individual cities in Northern England and Scotland, could achieve same kind of regeneration and economic benefits as Crossrail in East London”.

- Most businesses demand good access to markets and HSR line “would make Scotland a more attractive location for inward investors, enhancing the major city region status of the Glasgow/Edinburgh axis.”
 - While improving north-south transport links is “a necessary enabling factor in reducing productivity gap”, it is not sufficient “without other economic development measures.” In order to maximize agglomeration benefits and support the higher value business development outside London the HSR stations need to be located in city centers.
 - “The mix of economic activity will also affect the productivity impact of HSR. Cities with more extensive financial services and research sectors will benefit more quickly from a HSR connection than those without.”
 - To take full advantage of the wider connectivity of HSR link and achieve real benefits, cities or regions must be willing to change their economic development, planning and transport policies.

- *HSR technologies* fall into following two categories”:
 - (i) conventional railway based technology - can be either segregated (dedicated infrastructure and tracks) or integrated (shared infrastructure and tracks) with an existing rail network;
 - (ii) technologies “adopting alternative means of guidance and support” (Maglev) - can be only separate from existing railway network.

- *Segregated HSR network* is a dedicated network to the operation of HSR services alone. Rail operations depend significantly on the choice between segregated/dedicated versus non-segregated HSR network.
 - Segregated network operations are expected to have a higher degree of reliability since delays and problems on the conventional rail network would not interfere. However, segregated lines require significantly more new infrastructure and are thus more costly than non-segregated networks.

- In summary, the HSR scheme should be considered “in the context of the whole of the UK.” “Small scale schemes lack coordination, raise costs and negatively affect the benefits of the investment.” Therefore, the rail industry should view the HSR not as a rail project but more as a “national transport, economic and environmental projects”, because its “benefits and costs go far beyond the rail industry.” The options for North-South HSR line in the UK should be considered in an integrated manner with economic, environmental and transport

planning needs not only based on local rail capacity levels but also at regional, Scottish and UK national levels.

* * * *

Author: Blum, U., Haynes, K.E. and Karlsson, C. (1997)
Title: The Regional and Urban Effects of High-Speed Trains.
The Annals of Regional Science, 31, pp. 1-20.

Summary:

Blum et al. believe that high-speed trains can solve two problems of accessibility; either constitutes a good substitute to air travel or triggers the creation of a new economic corridor with high interregional accessibility. The main hypothesis is that cities that are connected with modes such as HSR are transformed into an extended functional region. They are mostly concerned with the economic integration in the corridor formulated by High Speed Rail in the short, medium, and long term. In the short-term analysis, they are studying the integrations of goods, service markets, labor markets, markets for shopping, private services and leisure activities. In the medium-term analysis, they lay emphasis on the household and firm relocation along the formulated corridor.

With the application of high-speed trains, they believe that the travel intensity will increase significantly and that economic growth will occur with the stimulation of the region and the extension of the markets. Before the presentation of their model, an analysis is carried out regarding the impact of high-speed trains to the following areas:

1. "Economic integration
 - a. In general
 - b. From the relocation perspective
 - c. From the regional adjustment perspective
2. Trade in services and knowledge exchange
3. Time gains for business travelers
4. Productivity differences and commuting cost
5. Shopping, service and leisure time"

They use an *equation* in order to measure the employment in sector j in region I depending on travel time and travel cost of commuters. While studying when equilibrium applies and the net benefit of commuting, they find that the former equation is non-linear in some cases.

The conclusion of their analysis is that there exists a combination of travel time and cost that under certain mode availability will lead to new location patterns, but non-linear reaction might occur after the line has opened up.

* * * *

Author: Bonnafous, A. (1987)
Title: The Regional Impact of the TGV.
Transportation, V. 14, No. 2, pp. 127-137, June.

Summary:

This is an empirical study on the regional impact of the TGV HSR between Paris and Lyons based on the surveys conducted before and after HSR inauguration. The emphasis is made on tourism and services industry and their impact on traffic flows.

- The study describes the services on the new line between Paris-Lyons, which opened in two stages: Southern section of 275 km in 1981 and the Northern section of 115 km in 1983. By 1985, a dozen cities were linked to the service, including Lyons, and since 1985 30 cities of the South-East region were connected to Paris.
- The study is concerned with the connections of the Rhone-Alps region, the second region of France, and its capital city of Lyons and other relatively important cities of Grenoble, Saint-Etienne and Valence with Paris. The French economy is characterized with great imbalances between Paris and the provinces in France, with "Paris holding a predominant role in French society and its economy". As depicted in Table 2, while population of Rhone-Alps region is "half that of the Paris region, its production is only 1/3 of that of Paris region, share of services for higher level enterprises is 1/5 and share of registered offices of top French companies is less than 1/25".

	Paris region	Rhone-Alps region
Population in 1982	10.07 million	5.02 million
Share of the GNP	27%	9%
Share of the population employed in the service sector (% of the national total)	43%	9.6%
Share of the registered offices of the top 500 French enterprises	77.6%	3%

Table 2: The Rhone-Alps region versus the Paris region (source: Bonnafous, 1987)

- The study raises a question of the effects on the regions from “bringing Paris closer to a regional hub which itself remains unchanged.
 - While transportation between Paris and urban centers in the provinces has improved, the connections between the cities themselves have not changed or even worsened if they are part of the TGV.

- To answer the above questions, a survey was carried in 1980 before the inauguration of the TGV to learn about what the motives were for business trips made between Paris and Rhone-Alps region among plane and train users. The same survey was then carried out in 1985 after the inauguration of TGV.
 - Special study undertaken in 1986 specifically assessed the changes occurring at the top-end of the service sector in the Rhone-Alps region after the opening of TGV. The survey interviewed 40 enterprises in the services sector
 - Other ex-post surveys were aimed at assessing the effects of HSR in the areas of “behavior of industrial enterprises when it comes to choosing a location”, “property business and town planning policies in the cities served by the TGV”, “tourism in the regions served by the TGV”.

- Results of the survey before TGV:
 - Business journeys on the route Paris – Rhone-Alps in 1980 were more concentrated around purchase and sales of services rather than of products. This confirmed that inter-city mobility was strongly linked to the service oriented business travel, and Paris was particularly strong in this sector. Therefore, “there were big risks to the enterprises in this sector in the Rhone-Alps region from the ‘proximity’ of their powerful Parisian competitors.”

- Evidence of effects from TGV on Rhone-Alps region based on the surveys post-TGV inauguration:
 - In the tourism sector, there are two contradictory effects: one being a drop in overnight stays in hotel due to increase in one-day return trips due to HSR, and second being an increase in the “tourist packages using the TGV”.
 - “Regional expansionist” enterprises have established themselves in the Parisian market – thus benefiting from the TGV. They have looked in Paris for client among medium-sized companies with which they were familiar, and accessed that niche of the Parisian market mainly in the field of publicity, in which they have the most expertise.
 - For specialized enterprises, whose market is outside bounds of the region or international, with TGV there is no longer a need to relocate to Paris as it is easily accessible. So, there is an emerging trend to look for clients in Paris but carry out work in the province with calm and different quality of life.
 - Overall, the survey showed that Parisians increased their business journeys to the Rhone-Alps region by 52% for the purposes of selling or buying services, while the residents of Rhone-Alps have increased their trips to Paris by 144% for the same purposes.
 - Since the TGV opened during the time of crisis, the expectations on major relocation of industries were not major. The TGV was only exceptionally a determining factor on choice of location. “The availability of TGV was regarded as a ‘bonus’”, but not a requirement. Its importance was given greater weight when other spatial constraints were considered.

- The surveys and studies presented in this report were done two-three years after the inauguration of TGV, however, these effects must be studied over a longer period of time to obtain more significant results.

* * * *

Author: California High Speed Rail Authority (2007)
Title: Bay Area to Central Valley Draft EIR/EIS.
Vol. 1, Ch.5 – Economic Growth and Related Impacts.
Retrieved from http://www.edrgroup.com/pdf/chapter_05_hsr_eir.pdf

Summary:

Investments on transportation result in reduction of travel time and cost, improved accessibility, and reduced accidents and air pollution. These improvements result in economic growth, since money is saved and can be used for other purposes, such as attracting businesses.

In this study an analysis of the potential growth-induced effects and related indirect impacts of alternative for the Bay area to Central Valley is presented. The goal of the analysis is to understand the growth effects in the local, regional, and statewide levels, from the point of view of population and employment change and land consumption.

First, an overview of the current economic condition of California is offered. Second, California's counties are grouped into seven geographic regions and alternative scenarios are built. The scenarios include the No Project/No Action alternative (situation as it is on the day of the study) and two HST alternatives. The economic growth impact was measured with the use of the *TREDIS macroeconomic simulation model*. This software estimates the economic impact of transportation investments on business output, business attraction, employment, and population. As far as demand and travel time and costs are concerned, those were forecasted by the *California Statewide High-Speed Rail Travel Demand Model*. The possible impacts considered for the alternatives are the following:

1. "Increased employment
2. Reallocation of employment
3. Population growth
4. Residential allocation
5. Employment and population reallocation to newly developed areas"

The methodology followed was the following:

- "Definition of transportation investments
- Estimation of transportation benefits with the use of the Travel Demand Model
- Estimation of direct economic impacts
 - Business cost savings
 - Business attraction effects
 - Amenity changes
- Forecasting of land consumption
- Assessment of potential secondary impacts"

The study continues with the investigation of the HSR impacts on traffic conditions for highways, roadways, passenger transportation services (bus, air, rail, and intermodal), goods movement, parking, and transit facilities. It also describes the potential impact of induced growth on air quality, noise and vibration, energy, electromagnetic frequency, and electromagnetic interference, land use, communities, property and environmental justice. Moreover, the following issues are further discussed:

- "Farmland and agriculture
- Aesthetics and visual resources
- Utilities and public services

- Hazardous materials and wastes
- Cultural and paleontological resources
- Geology and soils
- Hydrology and water resources
- Biological resources
- Wetlands"

For the last three categories, the urbanization forecasts resulted in conceptual urbanization footprints that were combined with GIS-based maps in order to estimate the changes.

* * * *

Author: de Rus, G. (2008)

Title: The Economic Effects of High Speed Rail Investment.
International Transport Forum. Discussion Paper No. 2008-16, OECD, Las Palmas, Spain.

Summary:

De Rus faces the investment of High Speed Rail as one more transportation investment whose economic benefits have to be studied before choosing to apply it. A cost-benefit analysis can help in the judgment of whether public funds should be allocated to this specific work.

High speed trains, which, according to European standards, are running at a speed of 300-350 km/hr are a very effective solution for reducing congestion, accidents, and environmental externalities. As far as the cost of its infrastructure maintenance is concerned, it can be compared to conventional rail; the problem lies with building costs, acquisition, operation, and maintenance of specific rolling stock which are very expensive. In addition, the question is whether there are social benefits that can support this new transport mode. Some of the several benefits that are produced by HSR are:

- a. "Passenger time savings
- b. Increase of comfort
- c. Generation of new trips
- d. Congestion and delay reduction in roads and airports
- e. Accident reduction
- f. Environmental externalities reduction
- g. Release of needed capacity in conventional rail lines and airports
- h. Development in less developed regions (wider economic impact)"

In economics, what matters is the net benefit of the construction. In order to achieve that, different scenarios (including air and road improvements) have to be built and compared to the HSR scenario, in terms of their net balance. The reason behind this is that modal split achieves equilibrium when users have compared the generalized costs of different modes available and have chosen according to those and their willingness to pay. Also, the scenario of 'do nothing' has to be included, where no projects are programmed for the future, and the networks stay the same as on the day of study, but with the projected demand according to current growth. This scenario is analyzed in order to investigate whether there is any case for making an investment.

The total social costs for building and operating a HSR line can be divided in the following categories:

- 1) User costs
 - a) Total time costs
 - i) Access time
 - ii) Egress time
 - iii) Waiting time
 - iv) Travel time
 - b) Reliability
 - c) Probability of accident
 - d) Level of comfort
- 2) Producer costs
 - a) Infrastructure cost
 - i) Planning and land (land expropriations are quite costly)
 - ii) Infrastructure building (ex. Terrain preparation and platform building)
 - iii) Superstructure (this is the cost for the rail specific elements such as tracks and signaling system)
 - b) Operating costs
 - i) Infrastructure maintenance (ex. Cost of labor and energy consumed)
 - ii) Operating costs (ex. Train operations, sales and administration)
- 3) External costs
 - a) Construction costs (ex. Barrier effect and visual intrusion)
 - b) Environmental costs (ex. Noise and air pollution, global warming effects)

It is worth noting that the average calculated ratio is not homogeneous along the network, and this has to be considered and not disregarded. The HSR benefits mostly come from the reduction of total travel time, the higher comfort and reliability that HSR offers, the reduction of the probability of accident, and the reduction of congestion that alleviates the congestion faced by other modes. Although the environmental impact of HSR is less than the other modes, it is not such an important element to consider. As far as regional impacts and inequalities are concerned, the impact of HSR cannot be captured with the analysis of cost-benefit. That does

not mean that those effects are not important. On the contrary, they should also be analyzed and considered in the process of deciding whether to invest on HSR or not.

The equation that the cost-benefit analysis suggests to be fulfilled in order for the HSR investment to be socially profitable is the following (see Figure 9):

$$\int_0^T B(H)e^{-(r-g)t} dt > I + \int_0^T C_f e^{-rt} dt + \int_0^T C_q(Q)e^{-(r-g)t} dt,$$

where:

$B(H)$: annual social benefits of the project.

C_f : annual fixed maintenance and operating cost.

$C_q(Q)$: annual maintenance and operating cost depending on Q .

Q : passenger-trips.

I : investment costs.

T : project life.

r : social discount rate.

g : annual growth of benefits and costs which depends on the level of real wages and Q .

Figure 9: Equation that has to be fulfilled in order for HSR to be socially profitable (source: de Rus, 2008)

The net present value of the benefits included in the above equation can be expressed as:

$$\int_0^T B(H)e^{-(r-g)t} dt = \int_0^T [v(\tau^0 - \tau^1)Q_0 + C_c](1 + \alpha)e^{-(r-g)t} dt + \sum_{i=1}^N \int_0^T \delta_i (q_i^1 - q_i^0) e^{-(r-g)t} dt$$

where:

v : average value of time (including differences in service quality).

τ^0 : average user time per trip *without* the project.

τ^1 : average user time per trip *with* the project.

Q_0 : first year diverted demand to HSR.

C_c : annual variable cost of the conventional mode.

α : proportion of generated passengers *with* the project with respect to Q_0 .

δ_i : distortion in market i .

q_i^0 : equilibrium demand in market i *without* the project.

q_i^1 : equilibrium demand in market i *with* the project.

Figure 10: Net Present Value of Benefits included in equation of Figure 9 (source: de Rus, 2008)

The literature review suggests that the rationale behind the investment of public funds to HSR depends on its ability to alleviate the congestion problem of road and air traffic, since it increases the capacity of the rail network. The direct benefits of time savings and the net

willingness to pay seem to be of no such importance. Thus, it is critical to investigate the airport capacity, rail and road network situation, and existing volumes of demand, in addition to performing the cost benefit analysis.

HSR and air transport

As travel distance increases, the market share of HSR decreases. HSR constitutes a great alternative when the travel distance is about 500-600km, because it competes with the access, egress and waiting time of aircrafts. Moreover, the comfort served in a train is of higher level than in an airplane. HSR is also punctual and reliable, whereas airport delays occur at a more frequent rate. To conclude, the generalized cost of air transport is penalized with the cost of security control and the need for passengers to arrive at the airport earlier because of security checks, an attribute that reinforces the attractiveness of HSR.

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Author: Gutierrez, J. (2001)

Title: Location, economic potential and daily accessibility: an analysis of the accessibility impact of the high-speed line Madrid-Barcelona-French border. *Journal of Transport Geography*, V. 9, Issues 4, pp. 229-242.

Summary:

The paper evaluates the predicted accessibility effects of HSR link between Madrid-Barcelona-French border by comparing two scenarios of “with” and “without” HSR. The indicators selected for the study to measure accessibility are weighted average travel time, economic potential and daily accessibility.

- Weighted average travel time: average travel time between each node and all urban agglomerations weighted by the mass of the destination urban agglomerations (e.g., GDP).
- Economic potential: “gravity-based measure” of the “nearness or accessibility of a given volume of economic activity to a particular point/region and can be interpreted as the volume of economic activity to which a region has access, after the cost/time of covering the distance to that activity has been accounted for”. This “indicator measures that economic potential of each place in each of the scenarios and the changes” caused by the new infrastructure such as HSR.
- Daily accessibility indicator: “number of possible business contacts (for business trips) and the market potential (for tourist trips)”; “measures how much population can be reached from a place (or can reach a place) in a certain travel time limit (4 hours) and the changes in accessible population brought about by a new infrastructure”.

- The paper analyzes the effect of the new line on increase or reduction of “disparities between cities” on three levels of geographical scale: international, national and corridor scales. From an international perspective, HSR will link the Iberian Peninsula in Spain to the rest of Europe via connection to the French TGV. From a national perspective, it will link the two cities in Spain – Madrid and Barcelona, and on corridor level it will link other “urban agglomerations” along the corridor.
 - The increase or reduction in inequalities in accessibility is measured by the coefficient of variation.
- Findings:
 - The three indicators provide different information on the accessibility issue. The highest average improvement in accessibility recorded the location or weighted average travel time indicator is for the main urban agglomerations (5%). Both the economic potential and daily accessibility indicators recorded similar average improvements in accessibility (by 1.5%) also for the main agglomerations.
 - The accessibility impact will be asymmetrical. Asymmetry holds for three selected indicators of accessibility: “reduction in travel time in a link between a small city and a large one leads to a larger increase in accessibility for the small city than for the large city”.
 - Changes in accessibility inequalities indicated by all three indicators show reductions in existing disparities *on international/EU level*: by 1.87% in travel times, by 1.37% in economic potential, and by 2.3% in daily accessibility. The spatial distribution of the effects of the new line favors the peripheral Iberian Peninsula, and ***“when a transport infrastructure mainly favors a peripheral space, it is obvious that it lessens the center-peripheral disparities”***.
 - However, *on national scale*, the line contributes to increase in the accessibility inequalities among the Spanish cities. This makes sense because the new line connects cities such as Madrid, Zaragoza and Barcelona, that at the national level are already highly accessible without the line, and these cities benefit the most from the new line, thus increasing the disparities between the cities.
 - *On corridor level*, where the study considers “exclusively the centers situation along the corridor”, the disparities in accessibility are reduced, because all three indicators “reflect the changes in accessibility asymmetrically, so that the smallest cities on the corridor (that are less accessible than the large ones without the line) are those which obtain the greatest improvements in accessibility from the new line.”
- The conclusions of the study:
 - “The effects of the new line on accessibility will be relevant not only in the northeast part of Spain, but also other areas of Iberian Peninsula and in the south-southeast of France, albeit unequally, according to the location of the cities with regards to the new line.”

- “Caution is required when considering the accessibility effects of a new infrastructure”, as statements may vary depending on the geographical scale and the accessibility indicator selected.
 - Accessibility effects will be emphasized at the EU scale “if EU relationships (i.e. trips over long distances)” measured by location or weighted average travel time indicator are highlighted.
 - Effects will be lower if emphasis is placed on the “relationships over short distances” measured by economic potential and daily accessibility indicators.
- The new line will reduce “accessibility inequalities among cities at the European scale” and corridor level, “but will increase inequalities at the national scale.”
 - At the national level the cities that have greatest increases in accessibility are already highly accessible without the HSR line.
 - On corridor scale, small and medium-sized cities will obtain greater increases in accessibility than the large ones (meaning that this will induce spreading of economic growth).
 - At EU level, the HSR line will reduce core-periphery imbalances because of better communication of Iberian cities with each other and with central regions, thus improving the accessibility of Iberian cities to EU.

* * * *

Author: Ishii, M. (2007)
Title: Flexible System Development Strategies for the Chuo Shinkansen Maglev Project: Dealing with Uncertain Demand and R&D Outcomes. Chapter 2. Master Thesis, Engineering Systems Division, MIT.

Summary:

This MIT thesis developed a quantitative model to evaluate the Chuo Shinkansen Projects considering the associated uncertainties and flexible system design. Chapter 2 of the thesis discusses the formation of “Extra Huge” Economic Zones (EHEZ) through connected two or more cities with high-speed train. This concept was developed by The Chubu Economic Federation (CEF) of Japan for evaluating the impact of a high-speed railway investment.

- The chapter employs the concept of EHEZ formation to explain the benefits of Lisbon-Porto high-speed railway project in Portugal.
 - “The construction of a new high-speed railway between Lisbon and Porto will enable people to move between the two cities more easily, leading to the formation of a larger economic zone.” The economic zones of Lisbon and Porto will be connected within one

hour, expanding the distance of daily activities, and a new economic zone may emerge as “the 17th largest scale of economy in Europe (US\$ 56.9 billion)”.

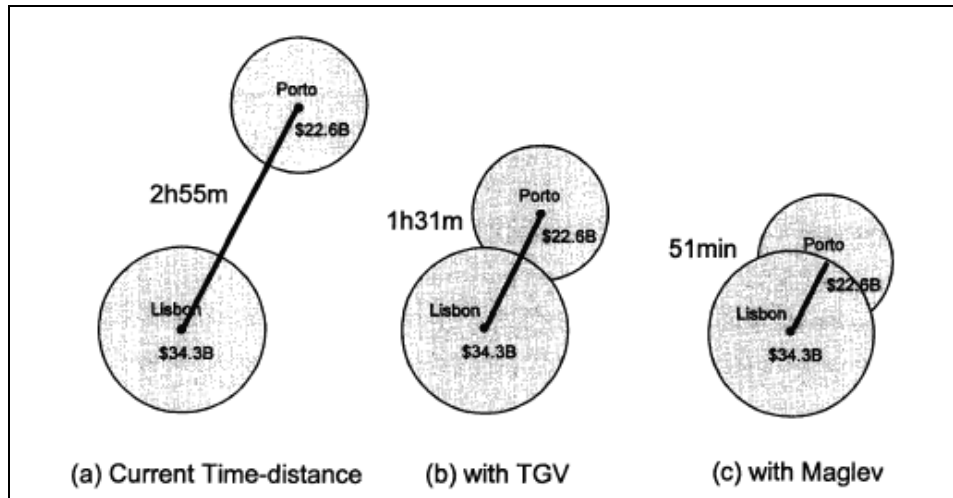


Figure 11: Time-distance diagram of Lisbon and Porto, with the Economic Magnitudes. Times-distance are based on the scheduled speed, which is 115 km/h, would be 222 km/h with TGV, and 400 km/h with Maglev. No stops are assumed in the calculations of travel time with TGV or Maglev. (source: Ishii, 2007)

- As a result, Portugal may become more economically attractive for investors and increase the levels of economic activity in the area. By forming EHEZ, Lisbon and Porto will be able to provide broader interaction between people and businesses and improve access to business information. Companies seeking for industrial sites may also become more attractive to EHEZs, thus increasing job opportunities and productivity.

Author: Knox, S. (2006)

Title: Can a High Speed Rail Line in the UK help to close the productivity gap between London & the South East and the Regions, and boost Economic Growth?
Transport Planning Society . Retrieved from
<http://www.tps.org.uk/files/Main/Library/2006/sknoxpaper.pdf>

Summary:

Knox is concerned with the question of whether high speed rail will help in the economic development of the UK. He assumes that “there is some sort of case for HSR in terms of cost-benefit analysis”. So, he is mostly interested in the wider economic effects that are not captured in the standard procedures and specifically in the potentiality for HSR to “contribute to closing the productivity gap between London and the South East and the three Northern Regions”.

He recalls research carried out by the European Spatial Perspective Observation Network (ESPON), which has estimated that regions experiencing increase of accessibility from the application of the European TEN-T, might increase their GDP by 4%. This percentage is not enough to alleviate the existing productivity gap of Northern Way. It is certain that large cities will be benefited, but will smaller ones be benefited as well or not? So, he tries to find out whether relocation of businesses will occur by investigating which of those are more attracted to time saving that HSR offers. He also analyzes the belief that time on HSR is really productive, since there is the possibility of video conference and mobile broadband internet. The influence of HSR on London and its huge agglomeration economies is also discussed.

It seems that HSR will help in the expansion of labor market and also in the linking of the economies. Moreover, economic benefits will arise from the increase of the capacity of the total network, since local and commuter rail services will be strengthened, and freight services will increase. Finally, it is believed that substantial agglomeration benefits will occur.

The conclusion of this analysis is the realization of the difficulty of quantifying the benefits of HSR, since there are many and both positive and negative. Furthermore, there are effects that have to be found a way to quantify since they aren't captured in the standard ways of appraisal but are really important, like the clustering of “knowledge industries” that exist in the UK. To answer the question set in the beginning the solution seems to be “the linkage of regional cities together without connecting them to London”.

Author: Lynch, T. (2002)
Title: Florida High Speed Ground Transportation Economic Benefit and Cost Impact restudy.
Retrieved from <http://www.cefa.fsu.edu/docs/maglev.pdf>

Summary:

Lynch is restudying the Florida high speed rail proposal. He focuses on four separate high speed rail studies already completed and calculates the costs and benefits into 2002 dollar values. The evaluation of the following parameters is being carried out:

1. "Economic benefits
 - a. HSR project life benefits in dollars
 - b. Net Present Value benefits
 - c. Average NPV of economic benefits created per linear mile
2. Economic costs
 - a. Net Present Value of construction costs
3. Operating costs to operate revenues
4. Job creation in absolute number
5. Benefit/cost ratio"

The economic impacts were estimated with the use of the *RIMS II* and *REMI econometric input-output models*.

The benefits of transportation are divided into "travel time savings, operating cost savings, accident costs avoided, and induced trips". The economic impacts of generated activities are divided into "sales among Florida firms, earnings by Florida workers, direct economic impact, and permanent jobs for Florida residents". Indirect benefits are categorized into "average household income and aggregate property value increase". Users' benefits included "consumer surplus, system revenues, and resource savings". Community benefits were measured by the estimation of potential increase in "employment, household income, and property values". Moreover, a sensitivity analysis was performed for the examination of impacts of changes in the corridor such as route alignment and socioeconomic outlook. Energy and air quality impacts were also studied.

The result of the researchers was that HSR will benefit the state of Florida by boosting the economy. A great number of jobs will be created, and salaries will increase.

Author: Pol, P. (2003)
Title: The Economic Impact of the High-Speed Train on Urban Regions.
European Regional Science Association EconPapers.
Retrieved from <http://www.ersa.org>

Summary:

Pol (2003) supports the idea that urban actors are the ones that determine the level of impact of new transport infrastructure. Everything is dependent on their reaction and on the strategies they develop. The question is whether there are certain preconditions to be fulfilled in order to help the improvement of external accessibility and whether threats are also generated.

Urban actors are all the inhabitants, companies and governmental actors. Spatial behavior is different for each of these, and it is believed to be driven by the maximization of their welfare. In order to maximize welfare, people either change their transportation behavior or their location behavior. Moreover, spatial behavior is connected with the “maximum acceptable transportation distance” (MATD) of the individual and in order to predict whether HST will cause changes either in urban actors’ transportation behavior or location behavior, it is necessary to explore the way they value transport costs. The MATD of each individual is closely related with his/her income, mobility, and purpose of travel. Moreover, it is explained that infrastructure investment does not occur simultaneously in all regions, thus leading to the increase of prosperity of those who are benefited by the application of new technologies.

There is a theoretical distinction that can be made between two different types of urban systems and those are the central-places model and the network model. The first model is dominated by one single central city, the positioning of which is determined by the diversity of services that it offers. The second model mainly consists of decentralized cities, and each city is positioned depending on the relation of its services with the other ones. HST will affect the development of cities, reinforcing the existing hierarchical position of cities, perhaps improving it, but also worsening it. The growth-pole effect might occur, where economic growth does not occur in a balanced way across the region. Also, the spread effect might be illustrated, as a result of the growth-pole effect, where economic activities are not center-located but are spread in the periphery. Backwash-effects are also possible to be noted in some regions due to the decreased accessibility that they will have after HSR is introduced and some areas will be benefited versus others. Last, it is believed that new horizontal urban networks will be formed with HST, and the interaction among such cities will be enlivened.

As far as the net impact of HST in the urban region is concerned, it can be depicted in Figure 12.

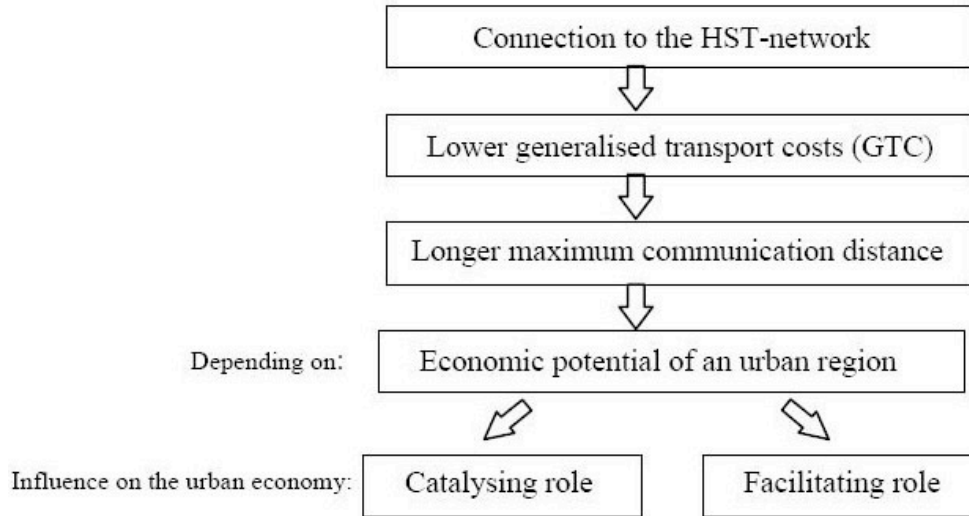


Figure 12: Influence of the HST on urban areas (source: van den Berg and Pol, 1998)

The “catalyzing effect” occurs when HST attracts new activities, the economy grows, and the facilitating effects when the city is already prosperous and is greatly benefited with the introduction of HST. This effect cannot be measured, since there are many other variables that influence economic growth.

The table that follows shows the categories that were developed by Schütz, who described three development areas that might be formed with the implementation of HST. According to the distance of the area and the HST station, he states the potentials of the location, the building density, and the dynamism of the development that might occur.

	OG1: Primary development zone	OG2: Secondary development zone	OG3: Tertiary development zone
Accessibility to and from the HST-station	direct 5-10 minutes on foot or by a transport mode such as a people mover	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. Specialised 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

Table 3: Development zones related to the accessibility of an HST-stopping place (source: Schütz, 1998)

All the issues discussed are performed in the city of Lille, France.

among regions according to their relative efficiency and requirement for investment. The outline of their model is depicted in Figure 13.

First, accessibility of each region is calculated according to the length of the line in each region, then the distance between the centroids of the region and the rail line, and, last, the number of passengers using the line. Then several formulas are tested based on the data collected. The data referring to the period 1975-1986 are:

- a. "Prefectural incomes
- b. Private investments
- c. Private capital stocks
- d. GDP"

The final suggestions for future research say that tourism attraction should also be studied. Also, factors such wage differences and housing market that affect regional dispersion or concentration of population should also be included in order for the model to be more realistic.

* * * * *

Authors: Schneekloth, N. and Broecker, J. (2003)

Title: Regional Impacts and Peripherality Issues.

5th seminar of the IMPRINT-EUROPE Thematic Network "Charges for heavy goods vehicles." Retrieved from

http://www.imprint-eu.org/public/Papers/IMPRINTHGV_schneekloth.pdf

Summary:

Schneekloth and Broecker are working in the IASON project which deals with the economic impacts of the TEN European transport investments and policies. The regional impacts of the infrastructure and the pricing policies are evaluated with the use of the following models:

1. SASI model: a quasi production function model (developed in the SASI project for the 4th framework program of the European Union)
2. CGEurope model: a spatial computable general equilibrium model (developed by Prof. Johann Broecker)

CGEurope is a comparative static non-monetary spatial computable equilibrium model in which the world is subdivided into 1373 regions. Static means that the comparison is performed with respect to the transport cost only, while keeping everything else

constant. Each region is allocated with a number of households that try to maximize their utility and firms that produce and trade goods and are maximizing their profit. The data needed are GDP, population, area characteristics, and trade flows in nominal values in Euros, which have been collected for the sake of this study from reliable European resources. Transport costs include specific characteristics of speed limit and likelihood of congestion and are composed of costs related to geographic distance (functions related to time and distance) and costs for overcoming impediments to international trade. The transfer costs of goods include both costs of freight and of personal contact for exchanging business information. The way users choose mode is calculated with a *logit choice model*. The scenarios were developed by the Institute of Spatial Planning of the University of Dortmund and were implemented with the use of GIS-based database available from the same Institute. Those assume a “with-world” version, in which the applied infrastructure or policy is applied and a “without-world” version.

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Author: Shin, D. (2005)

Title: Recent Experience of and Prospects for High-Speed Rail in Korea: Implications of a Transport System and Regional Development from a Global Perspective. *California HSR Series*. Working paper 2005-02. University of California at Berkeley.

Summary:

The paper talks about the regional disparity un development in Korea, where most economic activity has been concentrated mainly in Metropolitan Capital Seoul Region. The government’s attempts to impose de-concentration policies have not been successful. Recently, the government of Korea has been trying to embrace a firmer approach to achieve balanced regional development.

- Korean HSR Korean Train Express (KTX) alone is not a cure for concentration problem in the capital region. Reducing regional disparity became more difficult with KTX as Korea virtually became a daily-life zone due to KTX. Therefore, the government’s role is strong in ensuring that cohesive policies are in place aimed at boosting regional development, deconcentration, and growth of less developed areas.
- Lesson from Korean experience for the future:

- Additional stations would bring better accessibility, expansion of KTX services, however this will be at the expense of speed and travel time.
- Improving accessibility and connectivity of the stations would provide travel convenience, attract more ridership, and make HSR more economically viable.
- Good connection between KTX and international airports is important as it would drive more traffic to both airlines and KTX.

* * * *

Author: Shirocca Consulting (2004)

Title: Calgary/Edmonton High Speed Rail – An Integrated Economic Region.

Retrieved from

[http://www.vanhorne.info/files/vanhorne/HSRFullReport\(1062004\).pdf](http://www.vanhorne.info/files/vanhorne/HSRFullReport(1062004).pdf)

Summary:

- “User benefits (for business and non-business travelers)
 - Travel time savings in dollars – estimated from door-to-door travel assuming average access and egress time for all modes and average in-terminal and waiting time for air, bus and high speed rail. The value of time of business travelers is greater than the non-business travelers.
 - Travel cost savings in dollars
- Economic development
 - Short to medium term changes by measuring the employment expansion in number of jobs and the employment expansion income in dollars.
 - External attraction – business growth and attraction of businesses
 - Intra-provincial –specific location business growth and attraction along the HSR corridor

Those changes were modeled with the use of a business attraction model that captures the effects of changes in travel time and costs and has the ability to assess the corresponding impacts on business attraction. The disadvantage of this model is that it does not capture long-term and secondary effects.

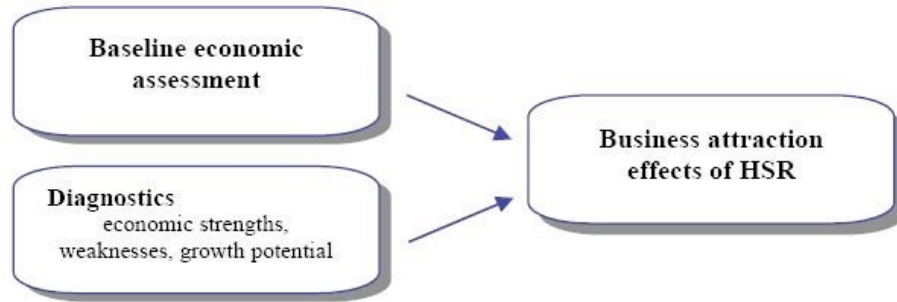


Figure 14: HSR business attraction model (source: Calgary - Edmonton High Speed Rail pre-feasibility study)

- Long term effects
 - Calgary-Edmonton complementarity
 - Competitive image - HSR will act as a catalyst to economic growth. It will give the potential to the corridor to be perceived as a single economic unit. Moreover, it creates the opportunity for the creation of greater economic cooperation and development between communities of the corridor.
- Property values - increase and especially near suburban stations
- Transportation network optimization
 - Road congestion and highway infrastructure - congestion problem might be alleviated
 - Average annual growth of daily vehicle volumes
 - Inter-modal connectivity and competition
 - Effect on inter-city bus transportation - might reduce its service quality
 - Effect on air transportation - add a mode choice for travelers
 - Rail freight operations and shipper benefits - contribute in the reduction of delays and improvement of speeds. Also, shipping cost shaving might decrease and create potential for existing and/or new businesses.
- Social benefits
 - Accident reduction in dollars
 - Re-shaping of growth and development - it will result in the shifting of development along the corridor and relief the pressure on land and prices in Calgary and Edmonton. The critical point here is that planning is needed in order for uncontrolled urban sprawl to be avoided.
- Environmental benefits
 - Air emissions - reduction of GHG in million metric tones
 - Noise - highway noise might be reduced, but there is the possibility of increased noise along the corridor

- Financial benefits both to residents and businesses
 - Construction employment
 - Construction employment income in dollars
 - Operations employment in number of jobs
 - Operations employment income in dollars”

* * * *

Author: Steer Davies Gleave (2002)
Title: The Case for Rail.
 Final Report. London. June.

Summary:

This report identifies the contribution made by the rail in order “to re-establish the case for rail services in general and for the funding and provision of sufficient resources to maintain and enhance rail services to achieve published Government policy objectives” in the UK. It identifies “what benefits the railway network brings and the contribution it makes to the economy, urban and rural communities and the sustainability of the way of life in Britain.”

- The report identifies the uses of the rail network and their trends, such as commuting, business travel, leisure and travel for friends and relatives visits. It tries “to provide an assessment” of the ways “in which rail makes a contribution” and “attaches values wherever possible” to justify “for the spending on the railways”.
- The paper states that as the economy grows the demand increases not only for business travel but even more for other types of travel such as “leisure and discretionary”. These uses in turn “can also have significant impacts on the economy and on the sustainability agenda”. “Accommodating this growth through the expansion of the road network” is not a “viable strategy for the future” due to its massive impact on “environmental, land use planning and social inclusion policies”. Therefore, the rail is a more sustainable way to go “towards achieving the necessary policy balance” in the growing economy.
- Different levels of rail’s impact on the economy are listed by this paper:
 - Rail enhances “international competitiveness” that contributes to “London’s World City status, a significant driver of the UK economy”;
 - Rail supports the “growth of regional cities” through promoting “the spread of economic benefits out of London and enabling key growth centers such as Birmingham, Leeds and Manchester to provide services nationally and serve the expanding workforce that their growth requires”;

- Rail supports “regeneration of regional cities [...] by providing access to jobs from surrounding areas of high unemployment” to regions such as Nottinghamshire, the Cardiff Valleys, etc.;
 - Rail impacts “land use” and density – “without rail there would be enormous pressures for dispersed lower density developments”;
 - “Rail is major industrial sector in its own – 130,000 jobs with an employment multiplier are six times greater within the manufacturing industry”;
 - Rail is “an important component in tourism – one of the largest sectors in the UK economy – bringing in over 1/3 of London’s domestic visitors and heavily used by overseas tourists traveling to other cities and some of the more remote parts of the UK economy, which rely on tourism for much of their income.”
- Rail is “vital to many of elements of the economy”; however, it is rather difficult to attach a numerical value to the benefits it brings. In most cases, to do this “we have to consider the counterfactual – what would happen if we didn’t have the rail network”?
- In summary, the study “identifies a wide range of external benefits that the railways bring to the country as a whole, and to individual sectors of the population and the economy” in the U.K., in particular:
- “enable the economy of London and other major cities to function and grow”;
 - promote economic regeneration and contribute to *development of regional economies*;
 - “allow business users” to travel fast from “city centre to city centre” while “working during the journey”;
 - “support tourism in many cities and rural areas, including more remote areas like the Scottish Highlands”;
 - provide equal access to all levels of “social classes, and income and age groups”.

Author: Vickerman, R. (1996)
Title: High-speed rail in Europe: experience and issues for future development.
The Annals of Regional Science, 31, pp. 21-38.

Summary:

This paper discusses the issues in evaluation of HSR network in Europe from the point of “competitiveness, network effects and corridor development.” It criticizes the development role assigned to HSR by urging “caution in approaches to the evaluation of individual projects.”

- French TGV:
 - The initial line Paris-Lyon was constructed gradually during 1981-83, and has had over 15 years of experience by now. The journey along the route was reduced to 2 hours (450km) and was successful in “trip diversion” and “trip generation” (total rail passengers increased from 12.5mln in 1980 to 22.9mln in 1992, of which 18.9 mln were TGV riders). “Most of the increase came from rail passengers and air (Paris-Lyon air traffic halved between 1980-1984).

- German ICE:
 - The German ICE has been mainly aimed to overcome bottlenecks in the existing network, while French TGV was largely focused on constructing “parallel network, using the existing network for access to major cities where new construction would be difficult.”
 - The urban structure of Germany is not “monocentric” as it is in France. Inter-city rail in Germany has always been “based on a complex interlinking network of services with interchanges which provide regular internal connections between most major German towns and cities, and more frequent operations on certain key links.” So, evaluating the impact of HSR in Germany cannot be in the same way as in France. Deutsch Bahn estimated that “12% of ICE traffic is diverted from road and air.” The “more patchy introduction of HSR has not had the marked shift in patterns of usage as experienced from the more concentrated introduction of TGV on all new line in France.”

- Spanish AVE:
 - Thus far the only single HSR route is between Madrid and Sevilla. Similar to the French TGV, AVE is aimed to overcome the capacity problem on the existing route. It also achieved major distance reductions by “taking a more difficult, but more direct route.” It was successful in traffic growth and diversion from air and road, though not at same scale as TGV. AVE bought in the technology rather than developing its own as France, Germany and Italy did. It married “French traction technology with German signaling”. The new route is also used by conventional trains using German built locos at 200km/h

and AVE at 280km/h. This was done to ensure access for point off the new HSR network.

- Italian diretissima:
 - Italian case is similar to the German one. Italy invested in new line in order to “overcome particularly difficult stretched of route.”
- The developments of HSR in Europe have occurred for many reasons but “without any clear overall plan” and “have instilled a mythical belief that they can solve transport and regional development problems.” There is not enough evidence to support this belief. The following are observations of the impact of HSR based on EU experiences:
 - *High-speed rail naturally increases the concentration of economic activity in Europe’s major conurbations.*
 - Since the main expected impact of any infrastructure is through increased *accessibility*. Studies suggest that “high speed rail improves both the competitiveness and cohesion dimensions by, in effect, shrinking the size of geographical space,” and increasing accessibility. Europe has indeed become more compact and all regions are closer to each other, but looking in terms of accessibility it is obvious that the biggest gains have been accrued to the major access points on the network. This differentiation is accentuated if the service quality such as frequency of stops is also considered. Cities located between the main access points may “suffer a reduction in absolute as well as relative accessibility if they lose current services” (e.g., in Belgium new lines by-pass some major towns).
 - In order for regions to gain a positive benefit effects from new high-speed rail developments very careful planning and policy intervention are required that would stimulate necessary ancillary investments. The causality of development impact of HSR is not always clear: “whilst improvements in accessibility reduce transport costs and improve competitiveness for poorer regions, richer regions are better able to afford, and therefore to invest in, infrastructure and thus maintain their advantage.”
 - Usually the investment in construction of HSR itself is the main source of growth that results in short-term benefits in the region (employment, construction expenditures, etc.). This would then make “road projects to be more beneficial to poor regions as they are more likely to use local labor and locally produced inputs, than rail projects, which are more technologically advanced.” In the long run, however, “growth in peripheral regions may be depressed if more efficient firms in more central regions are better able to exploit the new infrastructure to widen their own markets at the expense of indigenous firms.
 - Access to the network and how easy it is to access are the critical factors for the regions. Thus, for example, the existence and location of high-speed rail stations and good connecting services by all modes are essential for improving a whole region’s access.

- In conclusion, HSR while shrinking the overall space has a more complex effect on the “pattern of spatial development where peripheral major cities with new high-speed rail services gain at the expense of secondary centers in more central regions.” On average there is a gain in competitiveness for Europe as a whole, “but the effect on cohesion is much more difficult to predict” (Vickerman et al. 1995).
 - The main concern is that “the completion of a high-speed rail network in the European core” will lead to greater core-periphery divergences in accessibility, which in turn will impact the future economic development and location of economic activities.

D. Studies of Economic Geography and Regional Disparities

Author: Boddy, M., Hudson, J., Plumridge, A. and Webber, D. J. (2005)
Title: Regional Productivity Differentials: Explaining the Gap.
 Discussion Paper Series. Discussion Paper No. 0515.
 University of the West of England, Department of Economics.

Summary:

This paper examines the “determinants of regional productivity differentials across UK regions” using the data for individual business units. It finds that the differences in regional productivity can be explained by a “limited set of variables,” including “industry mix, the capital employed by the firm, business ownership, the skills of the labor force,” and location-specific factors such as travel time from London (proximity to center, London in this case) and population density. The analysis has “important policy implications”, specifically related to the effects of travel time, density and agglomeration. The work complements the studies done by Gardiner et al (2004) for the EU and Rice and Venables (2004) for the UK.

- In practice, there is a “lack of empirical evidence that identifies the factors “associated with differences in regional competitiveness and productivity.” The paper reviews the previous studies on the “*drivers of productivity*”, however none of those studies have quantified the effects of these drivers.
 - *Rice and Venables* (2004) “examine the determinants of spatial productivity differentials at the regional level across the UK.” Based on the economic geography theories, they “*relate productivity differentials to a measure of economic mass*” defined on the “basis of drive-time and the size of the working-age populations” in each region. They find that “over a third of the predicted spatial variation in UK productivity” is attributable to economic mass. “The proximity to economic mass has a significant effect on productivity and is greatest “within a 40 minute drive time.” Overall, “doubling the economic mass associated with a particular region... increases productivity by 3.5%” in the UK.
 - One of the points Gardiner et al emphasize is “the significance of spatial agglomeration, clustering and specialization as the basis for increasing returns.”
 - Other studies focus “on the determinants of productivity... at the level of individual form as opposed to territorial differences.”
- *Productivity differentials across the UK regions are substantial*, and have been a policy concern “on grounds of both equity and social cohesion” not only in the UK, but in all Europe.
 - London has the highest level of productivity.

- *Closing the productivity gap* has been seen on both European and national levels as a main factor for raising the overall economic productivity. The UK government has recognized that the “real economic gain for the country as a whole will only come from a process of ‘leveling up’... and has emphasized the importance in “raising the performance of the weakest regions rather than simply re-distributing existing ?
- The paper goes beyond the previous studies and “draws together a comprehensive set of explanatory variables” in a *single explanatory model* and analyzes their contribution to “regional productivity differentials in Britain.”
 - Data source used in the study is for 2002 and is “based on establishment level data held by the Office of National Statistics (ONS) in the Annual Respondents Database (ARD)” in the UK.
 - Skill data was “drawn from the Labor Force Survey.”
 - “*Locational variables*” includes indicators such as “population density and distance factors,” both travel time and distance in miles to “both London and to other major concentrations of populations, employment and economic activity (Leeds, Birmingham, Glasgow and Manchester).”
 - The dependent variable for measuring productivity is the log of Gross Value Added at Factor Cost (GVAFC) deflated using consumer price indices.
- *Empirical findings of the model:*
 - Capital stock per worker, ratio of full-time to part-time workers, skills and level of qualification of the local labor, ownership structure of enterprises, population density, as well as travel time to London have been found to have considerable effect on productivity.
 - “*Locational variables*” have been “found to be significant in determining productivity”.
 - Skill variables (qualification levels) are clearly significant in impacting productivity differentials in many cases.
 - Productivity was found to vary across the different sectors.
 - “Differences in industry mix have only minor impact on overall regional productivity differentials.”
 - It appears that attracting more businesses in financial services could potentially contribute to closing the productivity gap in lagging regions.
 - Catering sector has the least impact on productivity, thus regions dependent on this sector might benefit by promoting investments in other sectors that have “higher value-added”.
 - Ownership structure of firms has significant importance: substantial benefits are presented by the enterprises that are part of multinational entities.
 - Web access also has been found to promote productivity as “a proxy for innovation.”
 - Based on the “*new economic geography theory*”, the following findings support the argument “that clustering or agglomeration have some effects on productivity”:

- “Establishments located in areas of higher population density are more productive than others.”
- “Access to larger markets can bring scale economies. Larger urban centers provide access to large pools of labor and human capital with a variety of skills” as well as “access to a wide range of subcontractors, suppliers and specialized services.” Also, there are greater opportunities for “collaboration and interaction with other businesses,” networks and contacts, which in turn promote learning and innovation exchange.
- “The overall impact of peripherality” and travel time on regional productivity differentials has been found of importance.
 - Travel time to London has been found to have effect on productivity, specifically “the longer the travel time to London, the greater on average the productivity penalty on individual establishments.”
 - “Time distance to London may also be picking agglomeration effects rather than simply penalties in terms of travel time as such.” However, *reduction in travel time to London could “potentially spread the positive effects of agglomerations focused on London.”*
 - *Proximity to London has greater agglomeration effects than the population density does. It may also “represent the speed of knowledge diffusion where best practice spreads from the center (London) to other areas at a speed inversely proportional to peripherality.”*
 - “The journey time emerges as important rather than simply distance in terms of miles.” *This presents “clear policy messages here in terms of investment in transport infrastructure and the potential impacts on productivity.”*

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Author: Glaeser, E. and Kohlhase, J. (2003)
Title: Cities, Regions and the Decline of Transport Costs.
 National Bureau of Economic Research Working Paper Series, Working Paper 9886. Cambridge, MA.

Summary:

This article reviews the existing “evidence on the decline of transportation costs” for both the goods and people over the time. The authors “empirically test a number of implications” of this decline on “economic geography” of cities and regions.

- A few of the most interesting and relevant points discussed by the article are the following:
 - There are essentially “two major ways in which cities have changed” as a result of transportation costs decline for goods. First, the cities have changed their central locations and “their primary function”, moving towards serving mainly as “facilitator of

- contact between people". As transport costs of goods decline, the cities do not need to be located near "natural resource or natural transport hubs", but in places where the living and social conditions are more pleasant.
- "The location of manufacturing firms is not driven by proximity to customers or suppliers, but the location of service firms is determined by proximity". The previous studies by Dumais et al. (1997) and Kolko (2000) examine what "manufacturing and service industries" tend to locate near each other.
 - They find that the tendency to locate close to each other is "eight times more likely" for the *manufacturing industries* that "use the same type of labor" than those that just trade with each other. This means that for the manufacturing firms' decision of location choice, the transportation costs for moving people are more important than the costs of moving goods are (or goods transportation is cheap enough not to have large effect on the firm's location decision).
 - As for the *service industries*, Kolko (2000) finds that the service firms "using the same type of labor" as well as those "buying and selling from each other" have equally high likelihood to co-locate next to each other. This could be explained by the fact that "services involve face-to-face contact" and confirm the greater "importance of transport costs for people".
 - The paper makes several conclusions, among which are the following:
 - There is evidence of a "decline in transportation costs" over the last century, with a greater degree for goods and lesser for people. However, "in the last three decades" there have been observed some rise in the transportation costs for people moving within a city, which is mainly due to road congestion increases.
 - The cities have been changing "their locations and their primary functions" as a result of "reduction in transport costs for goods" and becoming more "facilitators" of face-to-face "contact between people".
 - Decrease in travel time (mainly by auto) "has allowed the cities to sprawl and eliminate any tendency towards a single city center". So, the future "new regional model" in economic geography is the one "without centers and without transport costs for goods".
 - Since there are gains "from people being able to interact", "productivity would be a function of agglomeration".

Author: Graham, D. (2007)
Title: Agglomeration, Productivity and Transport Investment.
Journal of Transport Economics and Policy, Volume 41, Part 3, pp. 317-343.

Summary:

This paper explores “the links between agglomeration, productivity, and transport investment”. It attempts to identify whether any agglomeration externalities arise from the provision of transport infrastructure, whether these external benefits “really matter and whether they might be important in assessing benefits of transport investment” and be included in the conventional “cost-benefit appraisals”.

- The paper begins with the review of existing empirical literature on “agglomeration and its effects”.
 - The literature defines “*agglomeration economies*” as “positive externalities induced through the spatial concentration of economic activity” (termed “localization economies”), distinguishing “between the effects arising from the scale or density of activity within an industry” and those arising “from urban scale or city size” (termed “urbanization economies”). The latter is of particular interest in our context.
 - *Benefits from urbanization economies* arise “from existence of local public goods, the scale of markets, the proximity of input-output sharing, and other kinds of inter-industry interaction”.
 - There are a number of recent “surveys of the empirical literature on agglomeration”. However, they all “exclusively focus on manufacturing” sectors. The lack of “published results on the link between agglomeration and service sector productivity” shows “a real limitation of the existing empirical works”. This is mainly due to the “poor quality of services sector data for most countries compared to manufacturing statistics”.
 - Literature review “finds the evidence of increasing returns to urban density for manufacturing industries and of returns to industry size”. This evidence has in turn “implications for assessing the benefits of transport investment”, as “ultimately, transport infrastructure is crucial in [...] supporting urban and industrial agglomerations” as argued by Venables (2004).
 - The studies’ estimates of the increase in productivity associated with “a doubling of the city size” range between 1 and 10 percent.
 - Venables (2004) has developed “a theoretical model” showing the “link between transport investment and agglomeration”. He argues “that estimates of the elasticity of productivity with respect to agglomeration can be used to shed light on the external benefits of transport improvements”. “Transport investment can strengthen the externalities of agglomeration available to firms and induce positive productivity benefits by effectively raising urban densities.” Venables (2004) refers to “these agglomeration externalities” that a transport investment generates as “wider benefits” because “they are not typically captured in a standard cost-benefit

- appraisal". These "wider benefits" can be quantified and "substantially increase the estimated gains of urban transport improvements."
- The author "develops an econometric model" in order to provide empirical evidence of the "link between urban density and productivity" for manufacturing and services sectors using the UK data.
 - The empirical analysis demonstrates "mixed evidence about the effect and strength of agglomeration economies for the primary and manufacturing sectors", such as agriculture, forestry, fishing, mining, etc. This can be explained by the fact that activities in these sectors "tend to take place away from large towns and cities and close to natural resources". For the same reasons, "weak agglomeration effect was found for production of electricity, water and gas".
 - Industries that showed "positive agglomeration external effects from increasing density" are "publishing and printing and the manufacture of food" as well as electronics manufacturing and construction sectors. This can be explained by the fact that these sectors "indicate efficiency gains from proximity to markets", which are near towns and cities.
 - If *transport investment* affects the "densities then there are likely to be important implications for economic productivity" as well. Since "the productivity is strongly associated with economic density", it is likely that transport investment induces "an increase in effective densities" that in turn has "associated productivity benefits via agglomeration". More specifically, as a result of transport investment the firms accrue benefits from becoming "closer to larger labor markets", from "improved access to input and product markets", and "from an increase in the scale and spatial concentration of other firms, which encourages the resources and knowledge sharing". So, *"agglomeration" leads to "efficiency gains" and improvement of transport provision affects "the intensity of this relationship by changing the level of agglomeration available to firms"*.
 - "Potential magnitude of agglomeration benefits" induced by transport investment is demonstrated through "an ex-ante cost-benefit evaluation" of the Crossrail project in the UK carried out by the UK Department for Transport (DfT).
 - The evaluation shows that "inclusion of the agglomeration benefits increase the total benefits of the Crossrail project by 25%" (as seen in Table 4), pointing to "that agglomeration benefits may not be trivial".

<i>Applying the New Appraisal to CrossRail (DfT Calculations)</i>	
<i>Benefits</i>	<i>Welfare (£ million)</i>
Business time savings	4,847
Commuting time savings	4,152
Leisure time savings	3,833
Total User benefits (conventional)	12,832
Agglomeration benefits	3,094
Total benefits (new approach)	15,926

Table 4: Applying the New Appraisal to CrossRail (DfT Calculations) (source: Graham, 2007)

- The paper notes that “not all transport investments or policies” will lead to increase of densities. Some may lower the densities resulting in “agglomeration costs rather than benefits in transport appraisal.” For example, “road pricing” policies may decrease “effective densities” for certain types of trips such as commuting trips but increase densities for business trips. Thus, *transport policies may induce agglomeration effects that “can reduce or increase the benefits”*.
- In *conclusion*, the paper reaffirms the argument formalized by Venables (2004) about the “relation between transport investment and agglomeration”. It provides evidence that “agglomeration effects matter”, especially for service sectors, and can “make a difference to the benefit-cost calculations” of the transport investment appraisal. “If transport investment changes the densities available to firms” by reducing travel times or travel cost, then the “gains from agglomeration” are likely to be positive and can be quantified as “wider economic benefits” of transport investment.

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Author: OECD/International Transport Forum (2008)
Title: The Economic Effects of High Speed Rail Investment.
 Discussion Paper No. 2008-16. University of Las Palmas, Spain.

Summary:

This is a discussion paper prepared by the roundtable participants organized by OECD and International Transport Forum (ITF) on Airline Competition, Systems of Airports and Intermodal Connections. It discusses the cost-benefit analysis framework and the conditions “under which the expected benefits... justify the investment in HSR projects,” focusing on the “intermodal effects and pricing.” The paper describes “the costs and benefits of the HSR lines”,

“the sources of benefits”, “the economic analysis of the investment in HSR”, and “economic consequences of pricing HSR services” and “its long term effects.” The “economic dimension of HSR investment decision” affects not only the transport sector but also how the resources are allocated.

- *European transport policy* has been defending “spending public money in the construction of HSR lines [...] as a socially desirable public investment” justified by such benefits as “passenger time savings, increase in comfort, generation of new trips, reduction in congestion and delays in roads and airports reduction in accidents, reduction in environmental externalities, release of needed capacity in airports and conventional rail lines, and wider economic benefits including the *development of the less development regions.*”
- While “conventional cost-benefit framework does not include the evaluation of the impact of transport infrastructure projects on regional development”, this report includes a brief discussion of the role of HSR in reducing “regional inequalities”. The authors pose a question whether “we should worry about these economic benefits in the case of HSR investment”.
 - The paper refers to Puga (2002), Duranton and Puga (2001), Vickerman (1995, 2006) and Vives (2001) who suggest that “in the case of HSR infrastructure, additional benefits are not expected to be very important”, because it has no impact on “freight transport” and thus the “location of the industry is not going to be affected by this type of technology.” As for service industry, “HSR may actually lead to the concentration of economic activity in the core urban centers” as opposed to spreading it to remote regions.
 - Reference is made to Graham (2007) who points out “that agglomeration benefits in sectors such as financial services may be greater than in manufacturing” and are relevant for “urban commuting cases”. So, since “agglomeration economies (productivity impacts)” are found not only in manufacturing and freight transport, they can be relevant to the HSR services that may form some kind of “form of commuting” by linking “major financial centers”.
 - The following quote from Puga (2002) summarizes well “the main findings regarding the effects of infrastructure investment and regional inequalities”:
 - “Firms producing in locations with relatively many firms face stronger competition in the local product and factor markets. This tends to make activities dispersed in space. However, the combination of increasing returns to scale and trade costs encourages firm to locate close to large markets, which in turn are those with relatively many firms. This created pecuniary externalities which favor the *agglomeration of economic activities.*”
 - Decreased transport costs can “affect the spatial location of economic activities” by “affecting the balance between dispersion and agglomeration forces”.

- The aim of the EU policies has been to reduce “regional inequalities” and “one of the main instruments for this is the improvement of transport infrastructure”. However, the objectives are not clearly defined, which makes it difficult “to compare the results of [these] different policies”.
 - There is clearly “no general indication of the direction in which the governments should push with regional policies when seeking efficiency” and equity. *Nevertheless, “policies that increase agglomeration may make those that remain in poorer regions better off by increasing production efficiency and the rate of growth.”*
 - The economic geography theory also points many “ambiguities in the impact of lower transport costs on” reduction in regional inequalities.
 - “A better connection between two regions with difference development levels not only gives firms in a less developed region better access to the inputs and markets of more developed regions,” it also allows the “firms in richer regions to [easier] supply poorer regions at a distance, and thus harm the industrialization prospects of less developed areas.”
 - These effects “depend on certain aspects of the economic environment such as mobility and wage rigidities and on characteristics of the projects”. However, the *HSR links are “likely to favor the main nodes of the network, and are unlikely to promote the development of new activity centers in minor nodes or in locations in between nodes”.*

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Author: Rice, P., Venables, A. J., and Patacchini, E. (2006)
Title: Spatial determinants of productivity: Analysis for the regions of Great Britain. *Regional Science and Urban Economics*, 36, pp. 727–752.

Summary:

The paper analyzes the “determinants of spatial variations in income and productivity” across regions in Great Britain, focusing on the effect of “proximity to economic mass”. The authors attempt to test the argument suggested by many economic geography theories “that *proximity to centers of economic activity increases measured productivity*”.

- The analysis is based on the regions of the UK, using the data from the Nomenclature Unites Territoriales (NUTS3) sub-regions of Great Britain. Disparities in economic performance across British regions have been increasing during 1995-2001.
 - GDP per capita in London was 54% above national average in 2001, while that in the poorest of the regions – the North East region – was 73% of the national average.

- The paper concentrates on “regional variations in income per worker” and poses the three main questions :
 - (1) “to what extent are regional inequalities a result of variations in the quality of jobs?”
 - (2) is there a relationship between differences in economic performance across regions and “proximity to centers of activity”?
 - (3) “what is the spatial scale of these effects”?

- Econometric investigation is conducted of the “determinants of spatial variation in a number of measures of economic performance”. The model includes four measures: GVA per hour worked, earnings, productivity index and occupational composition index.
 - Productivity index is based on the data on earnings by occupation, therefore is workplace-based.
 - Occupational composition index is a weighted sum of the share of each occupational major group in an employment area, with weights equal to the UK average earnings of the occupational major group”. It captures the “extent to which an area’s employment is in higher or lower paid occupations”.
 - GVA per employee hour works is estimate of “workplace-based gross value added at basic price”.
 - Earnings capture the average hourly earnings of all full-time employees.

- The investigation draws from the “*economic geography*” arguments that “*performance is associated with proximity to economic mass.*”
 - The *measure of economic mass* of each area is based on the area’s populations of working age. It was chosen by the authors over other alternative measures such as employment in order to reflect both the potential labor force in an area and the size of the local market.
 - The analysis uses travel time to quantify “*proximity*”.

- The study makes three main **conclusions** based on the found evidence:
 - (1) The authors find that *proximity of an area to economic mass measured by travel time is an important determinant of the variations in productivity among regions in Great Britain.* So, access to economic mass has a significant positive effect on productivity.
 - Study finds “considerable support for the hypothesis that proximity to economic mass raises income.” But the effects are observed through the productivity index, rather than the occupational income.
 - “Doubling the population of working age proximate to an area is associated with a 3.5% increase in productivity of that area.”
 - The *effects of economic mass proximity on productivity fall with travel time, becoming insignificant at about 80min or above.*

- Over 30% of “productivity variation” between regions in the UK is “due to variations in their access to economic mass” centers.” The effect is more significant for the lower productivity areas.
- (2) Cutting travel time to the centers of economic mass from 60 min of driving to 30 min would increase the impact of proximity “by a factor of four”.
 - Reducing all driving times in the UK by 10% would raise overall UK productivity by 1.2% and twice this amount for areas whose access to large population mass is increased the most, holding the qualifications and location of the labor force constant. (Table 5 demonstrates these findings).

	Average	Minimum	Maximum
UK average	1.21		
North East	0.88	0.53	1.04
North West	1.17	0.94	1.52
Yorks-Humberside	1.34	1.15	1.55
East Midlands	1.44	0.79	1.78
West Midlands	1.40	0.96	1.87
East	1.45	0.36	2.40
London	0.95	0.78	1.14
South East	1.40	1.08	1.76
South West	1.17	0.34	1.72
Wales	1.18	0.55	1.70
Scotland	0.85	0.00	1.69

In very low density areas speeding up transport has essentially no induced productivity effect, hence the low minimum values for Scotland and the South-West, whilst the highest value (a 2.4% productivity increase), is for an area between London and the Midlands.

Table 5: % productivity gain from 10% reduction in al driving times (source: Rice et al, 2006)

- (3) The occupational composition is found to be “positively correlated with productivity,” i.e. regions with high productivity levels also “tend to have good employment structures.”
 - However, no evidence is found on a strong “relationship between occupational composition in the area and its proximity to economic mass.”
- The results of this paper are consistent with other studies. A few of them are:
 - The US based studies “surveyed in Rosenthal and Strange (2004)”, where they conclude that “the elasticity of city productivity with respect to city size is in the range of 0.04-0.11.”
 - Ciccone (2002) “estimates an elasticity of productivity with respect to employment density for Europe of about 0.05.
 - Fingleton (2003) “reports a figure of 0.015 for Great Britain.”

Author: Tanaka, Y. and Monji, M. (2009)

Title: Post-Assessment of the Kyushu Shinkansen Network in Reference to the Proposed United States High-Speed Railway Project.
Transportation Research Board Annual Conference, Session 212. Paper No. 10-1092.

Summary:

This paper presents the post-assessment of the Kyushu Shinkansen project in Japan with an emphasis on the economic, social, environmental effects and traffic changes resulting from the project. The assessment was carried out by the Japan Railway Construction, Transport and Technology Agency. The assessment is to serve as a point of reference for the high-speed rail project in the U.S.

The Kyushu Shinkansen line is about 260 km long and connects Hakata and Kagoshima Chuo stations. The southern segment of the line (127.6 km long) linking Shin-Yatsushiro and Kagoshima Chuo stations was completed and launched in March 2004. The northern segment from Hakata to Yatsushiro is still under construction. The zone of the given post-assessment is therefore the southern segment. The maximum design speed of the train is 260 km/h. The travel time along the route was reduced by HSR by 90 minutes.

The post-assessment of the line was carried out after five years of operation. The computed C-B ratio resulted in the ratio of about 1.1. Major travel time savings up to 90 minutes were achieved. Overall, it is confirmed that the Kyushu Shinkansen line had a positive impact on the economy. Improvements occurred in quality, speed and frequency of transport services in the connected areas. The following are some interesting points concluded by the post-assessment:

- Implementation of Kyushu-Shinkansen line widened the area of economic activities. It streamlined business activities through reducing business travel costs, providing access to wider business opportunities, allowing a more efficient collection of information and simplifying organization of business meetings and negotiations. According to the business survey results, majority companies responded that the HSR line had a positive effect on their businesses, with less than 5% responding to have negative impact. Some of the additional positive effects include the increase in the number of conventions and conferences held in Kagoshima City, which attests that the new line helped to promote business exchange.
- Shinkansen was also found to be contributing to local communities, and the public chose it because of its convenience in traveling and commuting. The number of commuters for work and school from smaller cities to Kagoshima City increased substantially. As of 2007 the number of commuters by rail reached 11 times the pre-HSR levels.
- The direct impact of the new HSR line on tourism is not clear and further studies are necessary. But according to tourism statistics of Kagoshima City, the number of overnight

guests has increased since the construction of HSR and no tendency is observed for them to convert to one-day trip tourists due to Shinkansen.

- The public changed their travel habits. The share of rail traffic increased from 41% to 71% since 2004, and the share air traffic decreased from 42% to 72% in the area between Fukuoka and Kagoshima cities. In the area between Kumamoto and Kagoshima, the rail mode share also increased from 88% to 99.5%, and the bus share fell from 12% to 0.5% (mainly due to termination of the express bus services on the highway after HSR was built). The surveys revealed that 20% of Shinkansen riders switched from air and 25% - from auto. By trip purpose, 33% of Shinkansen business travelers switched from air and 35% of leisure travelers changed from auto to HSR.
- The Kyushu Shinkansen generated new demand: 17.8% of the total demand was induced according to user surveys.
- The CO₂ emissions of all transport modes in the affected zones decreased to about 80% of the emissions levels before the HSR (down from 78 t/day to 62 t/day). The most reductions come from the decreased air travel in the area.

E. Study of Forecasting Passenger Demand

Authors: Profillidis V.A. and Bontzoris G.N. (2005)

Title: Econometric Models for the Forecast of Passenger Demand in Greece.
Journal of Statistics & Management Systems, Vol.9, No 1, pp. 37-54

Summary:

Profillidis and Bontzoris have developed three econometric models for forecasting passenger demand in Greece. One is for estimating the total demand, the second for rail, and the third for private car demand. Before developing the models, analysis of the market share of each transport mode was carried out. The parameters that were found to be crucial were the car ownership and cost of fuel for the market share of private cars and the car ownership, GDP, rail fares, fares of competitive modes and travel time for the market share of railways and buses. The dependent variable was decided to be the number of passenger-kilometers. The independent variables for each model were the following:

Model 1 (total demand): GDP and cost of fuel (C_{fuel})

Model 2 (demand for private cars): Private car ownership index (I_{co}) and cost of fuel

Model 3 (demand for rail): Cost of fuel, private car ownership index, rail use cost per pass.-km (C_r), competition expressed as the cost of using bus instead of rail ($C_{b,r}$) and a time lag dependent variable that represents habitual inertia and constrains on supply ($D_{rail(-1)}$)

The final models were tested with eleven statistical and diagnostic tests and were finalized with the study of elasticities of independent variables. The final models are:

$$1. \ln D_{tot} = 1,667 * \ln GDP - 0,877 * \ln C_{fuel} + 0,991$$

$$2. \ln D_{car} = 0,691 * \ln I_{co} - 0,066 * \ln C_{fuel} + 1,723$$

$$\ln D_{rail} = -0,192 * \ln C_r - 0,078 * \ln I_{co} + 0,111 * \ln C_{b,r} + 0,109 * \ln GDP + 0,766 * \ln D_{rail(-1)} + 1,273$$

F. HSR Studies: General

Authors: Chen, X. and Zhang, M. (2009)

Title: High-Speed Rail Project Development Processes in the United States and China. *Transportation Research Board Annual Conference, Session 212. Paper No. 10-1200.*

Summary:

This paper reviews the HSR development processes in the U.S. and China from an institutional perspective. It evaluates the experiences of two cases – the California High-Speed Rail Project (CHSRP) and the Beijing-Shanghai Express Railway Project (BSERP) – and compares them on the basis of project management, planning, funding, construction, as well as broader institutional factors that may affect the decision-making of HSR development. Based on this, it draws lessons to inform “the strategic infrastructure investments in both countries”. These two cases were chosen mainly because of their comparable project scales and relatively close project readiness statuses.

Both projects have comparable track length, design speed and number of stations. CHSRP is a 1,280 km long high speed link that would connect San Francisco and Los Angeles metropolitan areas in 2.5 hours. The construction of CHSRP is planned to start by 2012 and to be completed by 2030. BSERP is a 1,318 km long line between Beijing and Shanghai. Its construction has started in 2008 with completion expected by 2012.

The investment in HSR is viewed as part of the national strategies in both U.S. and China. However, BSERP is more important for China geographically and economically than CHSRP is for the U.S. Due to larger population and lower car ownership in China, the BSERP’s ridership is expected to be much higher than that on CHSRP. Meanwhile, the CHSRP is a more costly project than BSERP is by about 40% because of greater land and construction costs in the U.S. China was able to mobilize the necessary resources to start the implementation of the HSR, while the U.S. “has had decades of studies on HSR” with federal funds being finally earmarked under the President Obama Administration.

The authors conclude that despite the political, economic, social and cultural differences between the U.S. and China, there are still lessons the two countries can learn from each other. China’s centrally oriented political system allows the government to take a strong leadership role to make decisions and mobilize resources for HSR rather quickly and to be essential in resolving inter-agency conflicts common in large scale projects like HSR. While the U.S. cannot adopt directly the Chinese institutional strategy for project development, “the idea of having a strong leadership for HSR projects may still be valid in the U.S. context”. Empowering the federal government in development of HSR could help attracting and boosting confidence of

the private investors to enter PPPs. PPP schemes are essential for large scale HSR like projects in order to tap into private financing sources. There are also useful lessons that China could learn from the U.S. such as the comprehensiveness of environmental assessment and involvement of the public in the decision-making process. Overlooking the environmental and social issues may speed up the project delivery, however may lead to a “backfire in the long run”.

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Authors: Guirao, B. and Soler, F. (2009)

Title: New High Speed Rail Services in the United States: Lessons from Spain.
Transportation Research Board Annual Conference, Session 564. Paper No. 10-2630.

Summary:

This paper discusses and compares the concept of HSR services as defined by the European countries with that defined by the U.S. Federal Railroad Administration (FRA). Then, it analyzes the fifteen year experience of Spain in HSR in terms of HSR’s impacts on mobility and makes recommendations applicable to the U.S. context.

Spain’s HSR network is centered in Madrid, covering over 1500 km. It offers long distance services as well as short distance shuttles with high train frequencies called “regional high-speed services.” Spain constructed its first 471 km long HSR line connecting Madrid with Seville in 1992, which was followed by another HSR line of 625 km linking Madrid and Barcelona.

The paper refers to the regional high-speed services or high-speed shuttles as resembling more “suburban train” operations for commuters. For example, the 171 km long Madrid-Ciudad Real city pair, which is part of Madrid-Seville line, was the first “regional high-speed” service in Spain (in service since 1993). Ciudad Real is a medium sized city with 70,000 inhabitants, connected to an “attracting center” Madrid within a 50 minute travel time via high-speed shuttle. The line generated great mobility between these cities and in 2002 the number of trips amounted to 892,744. For Ciudad Real and other similar cities the high speed connection defined the existence of so called “high-speed commuters”, which had important implications on the local mobility patterns and land use. The mobility was also found to vary according to the station locations (center, external station or located at the city’s edge).

The following recommendations are summarized for the U.S. HSR development based on the lessons from Spain:

- The classification of HSR defined by FRA should be revised to include more information on the quality of infrastructure and rolling stock. Differences between regional and express HSR should be based not on max speed but on trip distance or travel time.
- For distances between two HSR nodes less than 200 km there is potential for formation and existence of “high-speed commuters”, usually from smaller city to the large major city as seen in the case of Madrid-Ciudad Real link.
- Studying the location of the HSR stations and its impact on the local areas is also very important in analyzing HSR trips: the travel time to access the station has to be included to the total HSR travel time. Presence of public transport access and parking lots at the station must also be considered.
- Regarding the freight transportation, the Spanish HSR system has no experiences and is not prepared for accommodating this type of services.

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Authors: Kao, T., Lai, Y. and Shih, M. (2009)

Title: Privatization versus Public Works of High Speed Rail Projects.
Transportation Research Board Annual Conference, Session 212. Paper No. 10-2004.

Summary:

This research paper explores the effect of privatization on HSR projects by comparing the outcomes of HSR projects in Taiwan and Korea. Both projects were similar in their scope and objectives and had parallel execution timeframes. The only difference was in the delivery methods: Taiwan High Speed Rail (THSR) project was carried out as a privatized project and Korean High Speed Rail (KHSR) project – as a government-sponsored public work. Five criteria were employed to evaluate and compare the two projects: actual completion time versus initially scheduled time, actual cost versus the initially planned budget, actual quality versus the initially planned quality, achievement of the objectives, and meeting the users’ needs or user satisfaction. The first three criteria (time, cost and quality) represent the project management success, while the last two (meeting objectives and user needs) define the product success.

The construction of the THSR was delayed due to lack of privatization legislation and was awarded to private company Taiwan HSR Corporation (THSRC) under a BOT scheme in 1998 for a 35 year concession period. Construction started in 2000, and the first service was launched in January 2007. The 345 km high speed line links Taipei to Kaohsiung; six stations were constructed new and two were modified and shared with the conventional railway. The train operating speed is 300 km/h, with maximum design speed of 315 km/h.

Korean government took a decision to construct 412 km long HSR connecting Seoul and Busan in 1989, and in June 1992 the construction began as a government sponsored public work. The specially established Korean HSR Construction Authority was in charge of the construction. The project faced a lot of opposition from civil society, environmentalists, cultural heritage experts and religious followers. The first phase of the project was completed in April 2004 (Seoul-Daegu line). The second line, Daegu-Busan, is scheduled for completion in 2010.

Overall, the privatized THSR project was found to have performed better in terms of project management criteria such as time, cost and quality. However, the KHSR project carried out by the government has performed better in terms of product success criteria, i.e. achieving the set objectives and satisfying the users.

- THSR was scheduled for completion in 2005 but actually launched in 2007 (14 month delay), and KHSR was planned for full completion in 1998 but phase 1 launched in 2004 with phase 2 still to be completed in 2010 (63 month delay for phase 1 only).
- KHSR project had much larger cost overruns than THSR: \$6bln compared to \$1bln.
- The quality measured by the “on time performance” of HSR systems were reported impressive for both projects: 99.4% and 95.5% for THSR and KHSR respectively.
- As for objectives, THSR achieved only 28% of the forecast ridership and KHSR – 60%. KHSR was also able to achieve 100% its objective of technology development for HSR, which THSR did not plan.
- User satisfaction was found to be lower for THSR: initial ridership of THSR was much lower than that of KHSR (30,000 vs. 70,000 pax/day respectively).

The paper concludes that privatized HSR project due to more stringent project control has a better project environment to manage its times schedule, project costs, and quality. The quality could also be more dependent on whether any portion of HSR is shared with the conventional rail as KHSRP shares a part of its track and stations. However, privatized HSR projects may also take longer to build up the ridership due to lack of well-established intermodal connections. Therefore, privatized HSR will require a longer period to integrate into the existing transportation system, while the government HSR is already well integrated and viewed as an extended service. Moreover, privatization provides no incentives for concessionaires to pursue new technologies for overall rail industry development. On the contrary, the government-sponsored project may be more successful in promoting the national HSR industry and technology development as happened in Korea.

G. Transportation Project (Including HSR Projects) Financing and Value Capture Mechanisms

Authors: Plimmer, F. and McGill, G. (2000)

Title: Land Value Taxation: Betterment Taxation in England and the Potential for Change Retrieved March, 2011 from http://www.fig.net/pub/fig_2003/TS_9/TS9_4_Plimmer_McGill.pdf

Summary:

This paper briefly discusses the history of the betterment taxes and the reasons for the failure of these betterment taxes in the UK, in which betterment is defined in the UK as “the increase in value of land which results from actions other than those of the land owner”. The paper also discusses the rationale for the betterment taxes or land value taxes, and considers the potential of using land value taxation (LVT) to replace the existing property tax systems.

The existing forms of the betterment taxes in the UK include:

- Set off: “if a land owner has a claim for compensation against an authority but also retains land which increases in value, the amount of compensation is set off against the increase in value in the land retained, up to the level of that compensation.”
- Capital gain tax: according to the UK’s capital gain tax legislation, taxpayers are required to pay up to 40% of realized profits as capital gain taxes when selling assets including land properties.
- Rates and council tax: the council tax is “the imposition of an annual charge payable to the local authority on all taxable units (called hereditaments) in the UK”. This tax can be used as a source of betterment taxes since betterment is reflected in the net annual rents of domestic and nondomestic hereditaments.

The UK’s attempts to capture betterment since 1940 include:

- The Uthwatt Report 1942: this report “considered the issue of betterment in the light of the proposal to introduce planning permission across the UK. The report recognized the logic that, if the state has the right to grant permission to an owner to develop land, then all development rights must reside with the government.”
- Town & Country Planning Act, 1947: this planning act “assumed landowner had rights only to existing use value, but that the state owned all development rights. Alongside this, it introduced planning control of future land development; and the imposition of a development charge on prospective development value if and when realized.”

- Land Commission 1967: this act “introduced a betterment levy at 40%, initially, on all sales, grants of leases and provision was made for taxing of material development of land.”
- Development Land Tax and Community Land Act: this act proposed that “all land would be purchased by the local authority in England, at existing use value, and sold or leased to developers are a market price which reflected the full development potential of the site, thereby allowing the local authority to keep all of the development value to be spent on purchasing more land and improvements within the community.”

The rationale for betterment tax is also discussed in this paper: the added land values are paid for and achieved by community efforts instead of landowner efforts, so landowners have no right to claim these values; on the other hand, betterment taxes can encourage the government to improve community services and therefore enhance the property values.

Finally, in this paper, the author discusses the use of land value taxation (LVT) to replace the existing property tax systems to promote the sustainable development in the UK: LVT can promote sustainable development in the UK, because land would be taxed at its ‘highest and best use’ calculated in the development plan instead of the actual profits it has achieved. “Land with development potential which is left undeveloped and idle would be taxed as if fully developed in accordance with the development plan, thus encouraging the owner taxpayer to achieve the development for which taxation is demanded.”

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Author: Doherty, M. (2004). New South Wales University
Title: Funding public transport development through land value capture programs.
Retrieved March 2011 from
http://ecotransit.org.au/ets/files/land_value_capture_mdoherty2004.pdf

Summary:

This paper examines the relationship between the building of transport facilities and the change of land values, and the potential of raising capital to fund the development of public transport facilities using land value capture mechanisms.

Firstly, the author discusses the suggested connection between transport facilities and land value: there are studies showing “the increases in land value associated with transport projects has been seen in North America, the UK and Europe, as well as from a limited number of

empirical studies of Australian projects.” The methodologies used in these studies include trend-based extrapolation, modeling, accessibility mapping, qualitative surveys and growth assessments, and so on.

In addition, the author discusses different kinds of land value capture mechanisms, which include:

- Development land taxes: this tax is recently charged against the developers of land in Sydney, New South Wales. The author argues that “any levy paid by local landowners to fund transport improvements will be returned to them over the years in the form of increased land value.”
- Value increment financing: this value increment financing, or tax increment financing is used in the US and Australia to fund transport infrastructure improvements.
- Joint development: this joint development can be seen as “the cooperation between railway track owners (often governments) and private developers to specifically target railway property adjacent to, above or below rail stations for commercial and/or residential development.”

In the end, the author discusses the legal and political constraints of using value capture mechanisms. These constraints include:

- Notions of equity (understood across different indices).
- Constitutional limitations on the ability of governments to act.

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Authors: Iacono, M., Levinson, D. and Zhao, J. (2009).

Title: Value Capture for Transportation Finance. Retrieved March 2011 from <http://nexus.umn.edu/Papers/ValueCapture.pdf>

Summary:

The proposals of generating additional revenues from the general purpose tax sources to finance transportation projects often strong resisted by the public. To address this financing problem, this paper introduces value capture policy as alternative financing mechanisms for

transportation projects.

The author firstly provides the rationale for the value capture policy based on the benefit principle that “the cost of transportation for a contributor should be proportional to the benefits received” and by “placing it within a more general framework of transportation finance which defines different funding mechanisms on the basis of their relationship to specific groups of beneficiaries”. The author distinguishes three groups of beneficiaries: the unrestricted general public, restricted non-user beneficiaries (this group of people are definite as “not direct users of transportation facilities but who enjoy benefits because of their enhanced location advantages”), and direct users of transportation facilities. Transportation projects that benefit the unrestricted general public should be built using the fund of a governmental general budget; transportation projects that benefit direct users should be built using dedicated special revenues for transportation, such as gas taxes; transportation projects that benefit restricted non-user beneficiaries should be built using value capture mechanisms.

In addition, the author studies eight value capture policies in consideration of “which party contributes toward infrastructure provision (developers or property owners), what type of coordination each policy involves, timing, spatial extent of the policy, the basis of the infrastructure charges (whether they fall on new or old development), the types of costs they may be applied to, ownership of the transportation infrastructure, and the level of government responsible for administering the policy.”

- Land value taxes
- Tax increment financing
- Special assessments
- Transportation utility fees
- Development impact fees
- Negotiated exactions
- Joint development
- Air rights

Table 6: Features of Value Capture Strategies (source: Iacono et al, 2009)

	Contributor	Coordination	Timing	Space	Basis	Cost	Transport Ownership	Level of Government
Land value taxes	Property owner	Taxing Authority	Before and after implementation	Entire jurisdiction	New and old development	Upfront (Capital), Ongoing (O & M)	Public	Local
Tax increment financing	Property owner	Taxing Authority	Before implementation	Restricted off-site area	New and old development	Upfront (Capital)	Public	Local
Special assessments	Property owner	Taxing Authority	Before implementation	Restricted off-site area	Old development	Upfront (Capital)	Public	State and local
Transportation utility fees	Property owner	Taxing Authority	Before and after implementation	Restricted off-site area, entire jurisdiction	New and old development	Upfront (Capital), Ongoing (O & M)	Public	Local
Development impact fees	Developers	Taxing Authority	After implementation	Restricted off-site area	New development	Upfront (Capital)	Public	Local
Negotiated exactions	Developers	Negotiation	Before implementation	On-site	New and old development	Upfront (Capital)	Public and private	State and local
Joint development	Developers	Partnership	Before and after implementation	On-site, restricted off-site area	New and old development	Upfront (Capital), Ongoing (O & M)	Public and private	State and local
Air rights	Developers	Negotiation	After implementation	On-site	New development	Upfront (Capital)	Public and private	State and local

Finally, the author evaluates each policy based on the criteria of efficiency, equity, sustainability (in terms of revenue adequacy and stability), and feasibility. Here, efficiency refers to the ability of the policy to ensure an efficient allocation of society's resources; Equity, describes the fairness of resource allocation according to different stratifications of society; Sustainability refers to the ability of the policy to serve as a reliable source of transportation revenue; Feasibility evaluates the policies according to their political and administrative feasibility.

Authors: Martínez, L.M., and Viegas, J.M. (2007).

Title: Metropolitan Transportation Systems Financing Using the Value Capture Concept. Retrieved March 2011 from <http://www.civil.ist.utl.pt/~martinez/PDF/Paper%20PhD%20WCTR2007.pdf>

Summary:

This paper reviews recent research results of public transport's influence on property values, and evaluates the relevant legal framework and the economic-financial impact of the use of value capture solutions in financing public transportation infrastructure in several countries. This paper also examines the potential of and identifying the main obstacles for using value capture mechanisms to finance urban subway systems in Portugal, considering the current legal framework of Portugal.

This paper points out that the impact of public transport on property values has five features:

- The distance decay effects: the longer distance between the property and the public transport station is, the lower the value added is generated by the public transport to the property. Generally this land value impact is positive, but there is a distance threshold: if the distance is larger than the threshold value, the impact can be negative.
- The overall spatial impacts: "an improvement in accessibility is a necessary prerequisite for the increase of property value, but is not on its own sufficient. Its impacts depend on both the scale of the investment and on the contribution of the new link to the network."
- The timing of impacts: "The greatest general influence on property values was found to have occurred just ahead of the rail improvements. Impacts were greater for retail and leisure sectors than for the industrial and residential sector."
- The magnitude of travel time improvement: "transport investment is often necessary but not sufficient to generate development."
- The contextual and local economic factors: "there are also several important contextual factors that need to be considered, related both to the transport investment itself and to the broader local economic environment" These factors include:
 - The qualities of the transport corridor;
 - The economic climate;
 - Supportive public policies;

- Socio-economic factors.

This paper divides the land value capture mechanisms into two types: property related taxes and development land charges.

- The property-related taxes
 - Business rate levy (BRL)
 - Tax incremental financing/local tax re-investment programmes (TIF/LTRP)
 - Business improvement districts (BIDs)
 - Land value taxation/site value rating (LVT/SVR)
 - Land leasing
 - Greenfield development tax (GDT)
- Development land charges
 - Freehold levy
 - Planning gain/tariff
 - Buy-in charges

In the end, this paper points out that public acceptance, unforeseen and inequitable consequences, and legal issues should be considered before the use of value capture.

- Public acceptance: “public acceptance of these charges may depend on what relief is given from existing taxes and how effectively the related infrastructure objectives are presented.”
- Unforeseen and inequitable consequences: “All the schemes of land value uplift taxes and levies may impact harshly upon those least able to pay. An example is the case of the older person who is asset rich but cash poor.”
- Legal issues: “The legislative implications, including the form of statute necessary to authorize different funding schemes, needs close examination.”