Intercity Rail: A Comparative Analysis between the EEC and the US

This paper is an attempt to demonstrate that the success enjoyed by rail as a mode of intercity passenger transport in the European Economic Community (EEC) is not likely to be duplicated in the United States (US). There is no debate that rail is fundamental to the European transportation network. "Riding the train for Europeans is a way of life," says Southerland [1973], and rail remains the mode of choice for a "large share" of European intercity passenger trips, despite the automobile [TRB 1991]. In the US, however, another picture of rail emerges. The popular travel guide to the United States by Fodor describes the US passenger rail system as follows:

> "Amtrak's equipment, at best, is among the most modern and comfortable anywhere in the world; not all of the equipment is up to this standard, however; (sic) and the condition of the tracks and the adequacy of the auxiliary services (stations, meals, punctuality, etc.) is highly uneven." [Armstrong 1988]

The less-than-wonderful image presented here of Amtrak was summarized best by Southerland when he said in reference to performance of trains in Europe, "American trains simply do not compare." [1973] Yet a transportation problem in the United States does exist, and Americans seem to be ignoring a possible solution by allowing passenger rail services to slowly become extinct in most areas of the country. Putting all consideration of new high speed technology aside, why don't *existing* passenger rail services meet the standard set by their European counterparts?

To answer this question, the paper will explore passenger behavior in terms of mode choice. First, the motivation for this paper will be presented. A market segmentation study by Pas and Huber [1992] presenting new ideas about intercity rail passengers will be discussed, and a model

for mode choice based on the Rational Actor decision process will be developed from the market study. A set of criteria used to model mode choice will be presented, and the relative values of the criteria for American and European transportation systems will be compared. Finally, trends affecting the future of intercity passenger rail transportation will be discussed.

Motivation

The motivation for initiating this topic is shown in the form of an example in the following table. The cost figures in the table illustrate the failure of rail and bus to provide economic competition to air travel. I also find it fascinating that the trains were reserved to capacity more than three weeks ahead of time, but that plane reservations could still be easily obtained a week prior to departure. This fact was puzzling, considering the relatively small cost advantage and the huge travel time disadvantage of traveling by train. My curiosity was further piqued to learn that Amtrak, although completely booked for travel during the Thanksgiving holiday more than a month in advance, stated clearly that they had no intentions of increasing the number of trains or cars or taking any action at all to accommodate additional passengers who wished to travel by rail.

All of the information on the table caused me to think of the ease of travel which I experienced during a vacation to Europe, and to wonder why traveling by rail in the US was so impractical in comparison. Most interesting of all, though, was the fact that it takes half as long to drive a car from Harrisburg to Atlanta as it does to travel by rail. What could possibly cause a train to take so long, I could not imagine. Determined to find an answer to the question of why US passenger rail service compares so poorly with European service, I undertook the project of writing this paper.

Definition of Success

A practical definition for the success of a common carrier transportation system is ridership [TRB 1991]. The theoretical equivalent of ridership is mode choice, of the mode which a particular traveler chooses to execute his or her trip. The number of people who choose to ride one mode of transportation instead of other available modes is a good indicator of the attractiveness of that mode versus the attractiveness of the other modes. Ridership/mode choice also affects the future of a mode by providing revenue from fares and hence motivation for the carrier to provide service which is more attractive to the rider. Therefore, mode choice is the measure used in this paper to gauge the success of the transportation systems under consideration.

Model for Intercity Mode Choice

The key measure of success for a transportation system is ridership. Ridership of rail systems depends on distributing the number of intercity passenger trips among the various available modes for intercity travel. If intercity travel is considered to be trips between cities of 100 miles or more [TRB 1991], then the types of available modes are necessarily restricted to engine powered vehicles. Modes most commonly available in the United States for intercity travel are common carriers which include air, rail and bus carriers and the privately operated automobile, be it owned or rented. Given these choices of mode, now let us consider the various types of passengers who engage in intercity travel, according to trip purpose.

Market Segmentation by Passenger Type

Traditional segmentation of the intercity passenger market has yielded two segments: business travelers and non-business travelers, which includes tourists and all other non-business travelers [de Fontgalland 1984; TRB 1991]. Pas and Huber [1992] have, on the other hand, identified five types of travelers which comprise the potential intercity rail market:

- Functional Traveler
- Day Tripper
- Train Lover
- Leisure-Hedonic Traveler
- Family Traveler.

They suggest that segmentation of the market into only business and non-business segments may overgeneralize the attributes which characterize each segment, whereas creating more categories will allow the specific characteristics of each market to be more accurately represented, increasing the accuracy of demand forecasting.

The primary attributes used to determine the "utility" of train service by Pas and Huber were rail travel time, rail fare, number of daily departures, and seating. A number of secondary attributes were also considered, including availability of alcohol, increases in congestion and cost of other modes, availability of smoking areas and improvements to and relocation of station facilities.

The rather surprising characteristics of these segments are shown in the appendix. In this study, the largest market segments was the "functional traveler," although the authors were not able to confidently estimate the relative sizes of the segments for the actual population due to the nature of the sampling technique. Service characteristics important to Functional Travelers were short trip duration and frequent service. As shown by the chart in the appendix, this study suggests that there are more factors involved in mode choice, especially for market segments comprised of induced demand, than suggested by most existing models.

While intracity trips are commonly modeled using logit or probit models of mode choice which incorporate a stochastic element [Meyer and Miller 1984], the *planned* nature of intercity travel makes it more likely to be amenable to deterministic modeling. A study of attitudes toward

various transportation problems in the UK suggests that the more frequently a traveler makes a particular trip, the less likely he or she is to consider changing the way the trip is made. Conversely, trips made infrequently garner more thought from the traveler about the variables involved with travel. Due to the distances involved, intercity travel is most likely not an everyday event for most travelers. Therefore, more thought is probably put into planning an intercity trip than into commuting. That the intercity trip is planned implies that a rational decision process might be a good way to model mode choice.

Rational Actor Mode Choice Model

The functional traveler as described by Pas and Huber can be modeled as a rational actor. The rational actor decision process consists of identifying all alternatives, considering all positive and negative attributes of each alternative, and choosing the best alternative based on an evaluation of the attributes [Meyer and Miller 1984]. If the assumption of the requirement of planning for intercity travel in the United States is true (which is definitely the case for rail), then this model would seem to be applicable with some constraints to the functional traveler's mode choice decision.

Assumptions include that the functional traveler enters the decision process with predetermined origin, destination, and time constraint requirements. The first step of the process would be to determine all possible modes of transportation for the trip, limited by the predetermined input reflecting availability requirements. The second step of the process involves prioritizing of mode choice criteria, namely:

- Cost
- Travel Time
- Quality of Service
- Personal Preferences

and determining the values of these variables for each remaining mode choice. The mode which ranks highest according to the priorities of the individual is the mode which is chosen. The third step involves attempting to plan for that mode choice. For example, purchasing a plane ticket or reserving a seat on the train would be attempts to plan the intercity trip in terms of that mode choice. However, the functional traveler's first choice of mode may not always be available due to capacity limits. In this case, the rational actor would then attempt to plan using the second best mode choice, etc. It is also assumed that the "do nothing" alternative is included. The personal preference category adds an individual uncertainty component to the model.

Mode Choice Criteria

The mode choice criteria of availability, cost, travel time, quality of service, and personal preferences were chosen because they represented the most general categories of criteria for mode choice modeling found in the literature. It is not the intent of this paper to present a detailed modeling technique; however, a brief discussion of each criterion and its use in other models follows as an introduction to the scope of the suggested model.

Availability is the most basic criterion to consider when making a mode choice. It is impossible to choose and use a mode of travel which does not connect your origin and destination. In the case of planned journeys, availability should also be extended to include available travel times within your planned window of travel. In the case of unplanned journeys, availability becomes dependent on frequency of service. The criteria of availability is used to determine the set of feasible options for consideration by the rational actor.

Cost is an important determining factor in mode choice, and is included in all the mode choice models surveyed for this paper [Rallis 1977; Meyer and Miller 1984; Farris 1976; TRB 1991; Himanen, et al. 1992]. Costs are typically broken into out-of-pocket costs and hidden costs.

Travel time is also considered in all the above models, although it is often expressed as an element of travel cost or in terms of modal speed, or other more general service characteristics. Travel time appears to be more important to certain types of passengers than others, especially functional travelers [Pas and Huber 1992].

Quality of service is a catch-all criterion covering variables such as reliability and perceived safety [Rallis 1977]; comfort, prestige, and convenience [Farris 1976]; and availability of particular amenities which are important to particular types of travelers [Pas and Huber 1992]. In actually modeling mode choice, the quality of service criterion would be based on available data relating to the listed variables.

Finally, personal preference is a criterion used to incorporate the real stochastic nature of the mode choice decision into the rational decision model. Although an actor making a mode choice decision might not be aware of his or her reasons for feeling a preference toward a certain mode, including personal preference as a criterion allows the feeling to be incorporated into the decision process, since it would most likely impact a real mode choice decision anyway. Personal preference incorporates traveler characteristics into the model, which is done in [TRB 1991].

Comparison of EEC and US Intercity Passenger Systems

Compared below are the pros and cons of the EEC and US intercity passenger rail systems. Each factor of the above mode choice model is presented, and current status of the EEC and US regarding each criterion is noted.

Availability

Availability, as noted above, is the basic determinant of mode choice. If no train route runs from your origin to your destination, then travel by rail is simply not available as an alternative for you. The percentage of the continent serviced by European rail systems dwarfs the percentage of the US served by Amtrak. Almost every city in Europe can be reached by rail [Ford 1967], but in America, passenger service is only offered to approximately 500 cities [Armstrong 1988].

One reason for this difference is the "human geography" differences between the US and the EEC [de Fontgalland 1984]. The high population density of Europe makes a fixed route rail system economically feasible and more socially desirable because of its environmental and land use effects [Stone 1971], while the relatively low population density of the US favors the automobile and makes rail systems economically unprofitable except in certain corridors [TRB 1991].

Frequency of service also falls into the category of availability. In Europe, twenty to forty trains per day operate in each direction on most main routes [Ford 1967]. Approximately 40% of these trains stop only in major cities, while the remaining 60% stop at most intermediate stations. This means that as often as five times an hour you can depart from major cities and choose a train which suits your need for intermediate stops. In addition, for many types of tickets, there is no limit to how many times or for how long you may stop over at intermediate points between your origin and destination, and you can be fairly certain that from 8 AM to 6 PM you will find a train headed in the desired direction whenever you wish to depart.

In the United States, except for the Northeast Corridor, the frequency of service typically does not exceed two trains per day for weekday travel between major cities [see Table 1]. These trains usually require prior reservations and are often booked far in advance, limiting the potential rider to trips which have been planned well ahead of time.

Cost of Travel

The cost of travel is also an important determinant of mode choice, especially to certain types of passengers. All other things being equal, the lower the cost to travel by a certain mode, the more likely it is that the mode will be chosen. In Europe, rail systems are largely nationalized and partially subsidized, so travel by rail is cheap by US standards [Southerland 1973]. In addition, a tiered system exists which allows users to control costs by selecting a fare tier for acceptable or desired level of service and amenities [Daily 1990]. Finally, the costs of other modes of transportation are significantly more expensive than in the US, due to higher gas prices [Barrett 1992], road pricing [Jones and Hervik 1992], and regulation of airlines [Barrett 1992].

In the United States, the cost of owning and operating a private automobile is much lower than in Europe [TRB 1991]. With the intense intramodal competition for business experienced by US airlines, rate wars make the cost of air travel extremely low, often comparable to or lower than the cost of travel by rail [See Table 1]. Finally, since Amtrak has a monopoly on passenger rail service and receives subsidies for operation, it has little incentive to reduce passenger costs to compete with other modes. It also has one of the highest fixed costs of any mode of transportation in the US [Durr 1961].

Time to Travel

The time to travel has an important bearing on mode choice for certain passenger types, especially when costs and availability considerations are relatively equal. Most functional travelers (for that matter, 3 out of 5 of the passenger types defined by Pas and Huber) seek a mode of transportation which minimizes travel time within their cost and availability constraints. In Europe, trains are operated over short distances at relatively high speeds compared with the US. In addition, high speed rail alternatives which are competitive with total travel times for airlines are available at additional cost in Europe [Southerland 1973].

The nature of rail travel in the EEC is such that, although there are currently many opportunities to cross international boundaries, customs officials ride on the train and check documents while the train is moving, usually requiring little or no waiting time at borders. For most trains in the EEC, no reservations are required, and baggage is carried on to the train by the passenger without elaborate baggage handling systems, reducing the out-of-vehicle travel time. If reservations are desired, they may be made in advance. Trains stop at intermediate stations for usually less than five minutes, and since most trains are electrified, higher speeds with shorter acceleration times are possible. Thus, the in-vehicle travel time is also minimized. More intense track maintenance activities reduces the number of potential slowdowns. Finally, less stringent safety requirements in the EEC permit trains to travel at greater speeds with less regard for things like road crossings, the number of which is also minimized with infrastructures like over- and under-passes.

In the US, safety regulations combined with low service frequencies for many routes and relatively few infrastructure isolation techniques limit the speeds attainable on many routes. Speed is also limited by engine technology, track geometry, and acceleration limitations. Out-of-vehicle travel time is increased by check-in requirements and baggage handling provisions by Amtrak. Baggage handling also increases stopover time at intermediate stations.

Quality of Service

Quality of service of a mode of transportation was described above as a sort of catch-all category for characteristics such as reliability, safety, convenience, etc. European rail systems are internationally known for such attributes as being "clean, comfortable, quiet, smooth, and air-conditioned" [Southerland 1973], and de Fontgallard argues that their quality of service is "probably the highest in the world" [1984]. Trains are also noted for their reliability, boasting annually-fixed timetables and station arrival times within 10 seconds of the listed time [Southerland 1973]. For added convenience, rail stations are often located in the centers of cities

and are intermodal to facilitate passenger connections [TRB 1991]. Reservations are not required for most trains, but can be made at any train station if desired. Tickets are available in a variety of denominations, but come as a single unit which is inspected and punched along the way, rather than as a series of detachable stubs for each leg of the journey. In most cases, specific routes of travel are not specified on the ticket, so the passenger is free to choose a route of interest within the time validity of his ticket. Most of the European rail system shares a common computer scheduling system, so that what is now a multinational cooperative system really seems like a "single carrier" to the passenger [de Fontgallard 1984].

In contrast, Amtrak's service is described in Fodor's Travel Guide as "...highly uneven..." [Armstrong 1988]. In addition, rail stations are usually located in older, less safe areas of cities, with very few intermodal connections. The formal reservation process is an added inconvenience for potential Amtrak customers. Finally, the ticketing system used by Amtrak is at the very least confusing and cumbersome.

Personal Preferences

The aspect of mode choice which involves personal preferences is not easy to characterize. However, the flexibility of European passenger rail systems as noted in the above sections provides more possibilities for satisfying the individual requirements of intercity travelers than does the current rigid structure of Amtrak's passenger service.

Summary

In all the mode choice factors considered above, the EEC rail systems outperform their US counterpart. In the author's opinion, this is due to the lifestyle forcing which occurs in Europe to restrict and discourage the use of other modes of transportation, leading to subsequent demand for the best possible performance from rail systems. Due to the vast US resources and lesser degree of regulation in this country, other modes of transportation can compete with rail to the

point of nearly forcing its demise. The next section of this report will examine the future of passenger rail in the United States in terms of observed trends in the literature.

Future of Rail in the United States

Several trends have been mentioned in the literature which are likely to affect the future of intercity passenger rail transportation in this country. These trends involve technology advances, environmental concerns, and demographic projections, and indicate a more positive future for rail in this country, if we can progress beyond our short-sighted, "passionate psychosexual attachment" to the automobile [Southerland 1973].

Technology Advances

The success of high-speed rail in Europe and Japan has prompted the serious consideration of implementing similar systems in this country [TRB 1991]. The required technology is currently feasible and has been demonstrated in other countries. This type of rail service is more likely to suit the "human geography" constraints of this country as discussed earlier, with speeds comparable to air travel enabling competition for airline passengers traveling between 100-500 miles. The main barrier to implementation of high speed rail systems is cost, which is not likely to be recovered from revenues unless ridership is extremely high or fares are high, subsequently reducing the competitiveness with air travel. However, several systems are currently in the planning and development stages in this country, with estimated implementation dates as early as 1996 for some systems [Jones, Del 1992].

Environmental Concerns

With the growth of environmental consciousness in this country, many Americans have modified their lifestyles to preserve the environment in ways like recycling and energy conservation. If people are helped to realize the benefits rail transportation has over other modes in terms of the environment [Itzkoff 1985], the public perception of rail and its role in this country may

gradually change. Increased public interest may spur necessary improvements in the overall quality of rail service, causing a positive cycle which may mark the beginning of the next era of rail success in this country.

It may also be that current environmentally harmful practices like individual commuting will continue until direct regulation or lifestyle forcing is required to get individuals out of their cars and into more efficient modes of transportation. However, if the current atmosphere of environmental consciousness is used to increase America's awareness of the benefits of rail, these direct measures may be less painful.

Demographic Projections

The ever-increasing population of the world and the United States [ADM 1984] will eventually lead to densities where passenger transport by rail is more feasible than other modes of transportation. This scenario is quite distant, however, at least for most regions of the country.

The increase in the median age of Americans [ADM 1984] indicates a growing number of older citizens in this country. For reasons such as safety, comfort, and absence of medical restrictions, this segment of the population is more likely to be attracted to rail as a transportation alternative [de Fontgalland 1984]. This is a market segment which definitely bears consideration as a potential rail market, since many of these people have the financial wherewithal to travel and may be affected more by induced demand of improved rail systems than other passenger types.

Summary and Conclusions

The trends considered above spell out a more positive future for rail in the United States. In its current state, however, passenger rail in the US cannot hope to compete with its European counterparts because of competition from other modes in this country and restriction of alternative modes in the EEC, as well as the "human geography" which comprises this country.

However, trends in technology, environmental consciousness, and demographics seem to indicate that there may be a better chance for intercity passenger rail transportation in the future of the United States. It is the responsibility of all individuals to begin the trek toward a better future by working for a US transportation system which includes rail transportation.

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