JKAU: Eng. Sci., **vol. 13 no. 2,** pp. 3-16 (1421 A.H. / 2001 A.D.)

Characteristics of Intercity Travellers in Saudi Arabia

H.M. AL-AHMADI[*], M.A. AL-SUGHAIYER[*] and G. ERGUN[**]
[*]*Civil Engineering Department*
King Fahd University of Petroleum & Minerals
Dhahran, Saudi Arabia
[**]*Civil Engineering Department*
Bogazici University, Bebek, Istanbul, Turkey

ABSTRACT. Saudi Arabia has become a very affluent society in the last few decades and as a result of this affluence, demand for intercity travel has increased dramatically. The main goal of this study is to investigate the characteristics of intercity passenger travel and its proportion within the context of intercity travel mode choice in Saudi Arabia.

The characteristics of intercity travel and its proportion were analyzed via published statistics and data collected for this purpose. The data was collected from self-response questionnaire forms distributed and collected to/from travellers throughout the Kingdom while they were travelling. A total sample size of 3557 was obtained.

The trends in local intercity passenger travel seem to follow closely the developments in the total revenues of the country. A high proportion of automobile and air travellers, 21.63 percent and 23.8 percent respectively, were found to be captive riders. Intercity mode choice decisions seem to be affected by household income, travel distance, number of family automobiles, nationality and family size.

Introduction

Within the last few decades Saudi Arabia has become a very affluent society and as a result of this affluence and the improvements in the intercity transportation facilities, demand for intercity transportation has increased dramatically. Intercity travel in Saudi Arabia also has certain special characteristics. First, a significantly high portion of the intercity trips are made by air. This is because it

is still a relatively cheap and comfortable means of travel in a desert environment. Second, different local customs may affect intercity travel choices. Third, there are some different trip purpose categories such as *Aumra* and *Hajj* trips (religious trips made to the holy cities of Makkah and Madinah during the year and during the Hajj season respectively). Fourth, students receive a fifty percent discount on air and train fares. Last but not least, a significant portion of the current Saudi work force is made up of expatriates who, because of their special status and characteristics, have a significant influence on intercity travel patterns.

The main goal of this study is to investigate the characteristics of intercity passenger travel and its participants in Saudi Arabia. These characteristics were obtained mainly from a data set which was collected as part of this study. A high proportion of automobile and air travellers, 21.63 percent and 23.8 percent respectively, were found to be captive riders. In this paper, the specific objectives to define captives in Saudi Arabia are as follows:

1. Investigate the proportion of captive riders for various modes, trip purpose and origin-destination pairs for the intercity in Saudi Arabia.
2. Investigate the socioeconomic characteristics of the captive travellers in comparison with those of choice riders.
3. Investigate the differences in mode perceptions between captive and choice travellers.

This paper consists of four parts, first, the general characteristics and historical developments of intercity travel in Saudi Arabia are given, then the data collection is described, followed by the analyses of the characteristics of the intercity travellers, choice and captive, and finally, a summary of the research conclusions is presented.

I. Background

Stopher[1] discussed the issues related to captivity in general, and the effects of including captives in model calibration and prediction in particular. Through a theoretical discussion, he concluded that the inclusion of captives in the data for choice models, whether for calibration, prediction or both, would have serious effects upon the products of the model. Thus, he suggested that captives be always excluded from any use of a choice model.

Ergun, Stopher, and Al-Ahmadi[2] proposed how to handle captivity through stated choice set. In their study the respondents were asked to state their choice set, and to determine captivity from these stated choices. They found that this approach is feasible and the models built by using stated choice sets and after the elimination of captives resulted from stated choices were superior to other models obtained by using universal choice sets.

Van der Tol *et al.*[3] found that almost twice as many persons in clerical and sales occupations were captive to public transport in intercity travel as in the other occupation categories (labor, service, managerial and professional).

Wilbur Smith and Associates[4] developed a relationship which related the proportion of captive and choice riders in urban areas to the population of the area. They reported that 85-90 percent of the transit ridership were captive to transit in cities with one to two million population.

Moralla and Morahs[5] developed two separate relationships for choice riders alone, and for choice and captive riders together, relating a transport system variable respectively. Their research indicated the seriousness of the captivity issue in the intercity context.

Intercity Travel in Saudi Arabia

During the decade from 1970 to 1980, when there was a tremendous increase in economic wealth as a result of increased oil production and prices, intercity travel increased at a very fast pace. For instance, between 1975-1980, intercity travel grew at an annual rate of 27%[6]. However, in the early eighties, oil prices started falling and the total number of intercity trips increased only by about 6.2 percent (from 37.5 million in 1982 to 39.8 million in 1992). Intercity bus services in Saudi Arabia were introduced gradually, starting the late seventies. They attracted a considerable amount of passengers who had previously travelled by air. During 1982, there was an increase in bus fares and consequently travel lost a significant amount of its market share.

By the early eighties, some major intercity freeway systems had been completed. For instance, a 6-lane freeway between Riyadh (the capital, some 400 km to the west of Arabian Gulf) and Dammam (a major city on the Arabian Gulf) has reduced the travel time between these two cities almost by half. With these developments, automobile trips increased from 26 million person trips in 1980[6] to 32 million trips in 1992 (Al-Ahmadi *et al.*[7]).

Currently, train services only operate between Dammam and Riyadh. This is a regular train service which attracts only a very small share (1.0 percent in 1992) of the total market. Ridership in this mode increased as a result of increased operational frequency and a shortening of the route length.

An international comparison in the modal choice for intercity travel, using passenger-km, is given in Figure 1[8]. It should be noted that in Japan, where various high-speed rail transportation has been introduced and has been successfully operating for some time, rail ridership takes a significant share of the total market. With almost 26% of the total market, air share is high in Saudi Arabia

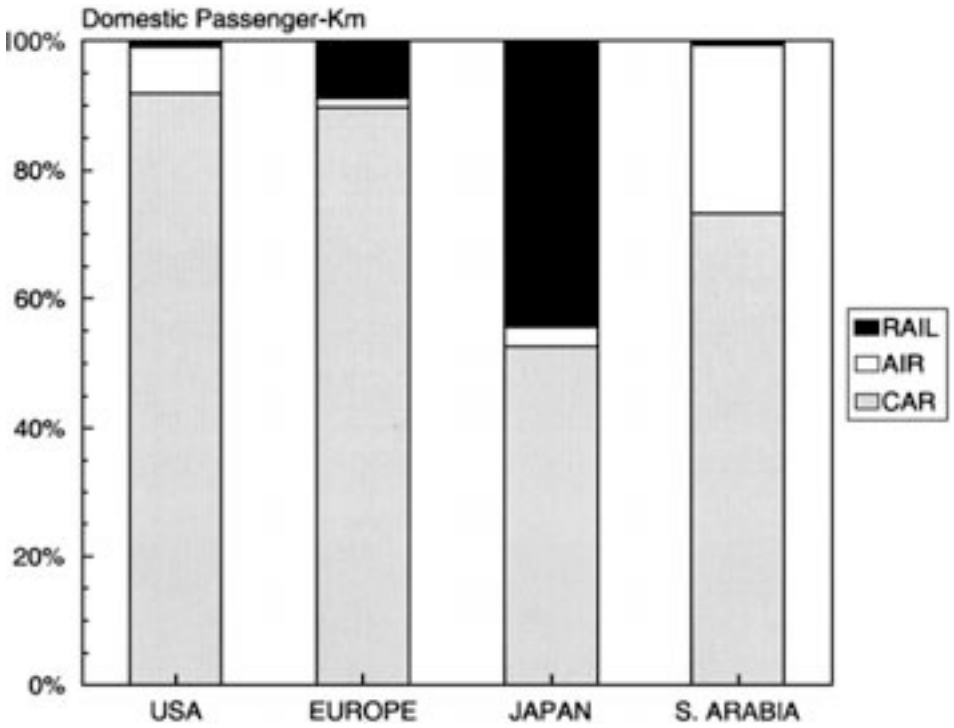

FIG. 1. Modal distribution of domestic intercity passenger travel.
Ref: Safford[8]

compared to other areas. This is mainly because, first, air service is operated by a national company (Saudia) which is subsidized by the government resulting in fairly cheap air fares. Second, in the desert environment, it is more comfortable and less risky to travel by air. Third, students are eligible for a fifty percent discount of the normal air fare. However, air travel market share has been steadily decreasing since the early eighties. This can be attributed, first, to a general drop in intercity activity due to decreasing oil revenues, second, to the opening up of an intercity freeway system and improvements in the road network, which have reduced travel times considerably between main centers.

II. Data Collection

The data of this paper was generated from a comprehensive study[7], the purpose of which was to build intercity disaggregate mode choice models. The data was collected with thorough interviews performed at air, bus, train modes and at roadsides with automobile passengers.

Data needs were decided based on a literature search and three sets of variables were collected, namely: data regarding the trip (such as origin, destination, trip purpose, etc.), level-of-service variables (such as in-vehicle time, access time, travel cost, etc.) and socio-economic variables. Furthermore, a question about whether or not the travellers would consider other means of travel was asked, in order to have an idea about the choice-set formulation by the travellers and to determine the travellers who were captive to a single mode.

The survey instrument and the questionnaire form, was developed as a self-response type and was distributed to travellers while they were travelling. Help was provided for those who needed it and the questionnaires were collected immediately after the respondents had completed them.

Sample size

A choice-based sampling was used, i.e. sampling was made separately for each mode. Keeping in mind the data needs for model calibration and model validation, a sample size of around 500 was deemed sufficient for air, bus and automobile, which were the major means of intercity travel. To obtain information about the characteristics of the train travellers, rather than include them in the mode choice model, a sample size of 200 was aimed at for train mode. The sample strategy for air, bus and train was to first select a scheduled flight, bus or train randomly from total weekly scheduled services, then to systematically select (i.e. select every nth) an incoming passenger at airport gates, bus stops or train stations for the selected service. Auto travellers were interviewed, again on a sample basis, between major origins-destinations in Saudi Arabia, at selected gas-stations. The data was carefully checked and corrected, if needed, manually and with the help of computer programs written for this purpose. The final corrected sample sizes obtained for the four modes are given in Table 1. Higher than required sample sizes for air and automobile riders were obtained for more detailed studies of these specific modes.

TABLE 1. Actual sample sizes for the field study.

Mode	Total sample size
Air	1357
Automobile	1276
Bus	670
Train	254
Total	3557

III. Age Characteristics of Intercity Travellers

The age distribution of the interviewed travellers and the general public (using the latest available census results[9]) is given in Table 2 for comparison purposes. Obviously the majority of the intercity travellers fall in the category of 20-39. It should be noted that children less than 12 years old were not interviewed. The percentage of higher age category travellers of 40 to 59 is more than the general population percentage. A smaller percentage of elderly people (over 60) was observed in the sample than in the general population. A higher percentage of the active age category (20-50) is expected among the intercity travellers. Therefore, these differences seem natural and not necessarily the result of biases in the sample.

TABLE 2. Comparison of age distribution of travellers and general public.

Age category	1992 Census[9]	Intercity travellers
0-19	50.5	6.4
20-39	33.9	69.0
40-59	11.5	22.9
60^{+}	4.1	1.8

Captive travellers and trip purpose

The interview form included a question about captive riders as follows: "Would you consider using the following means of travel for a trip similar to the one you are making now?" The answer to this question was one being used, using the following scale:

will never use it

may consider using it

will definitely consider using it

If a traveller answered using the first response for all the modes other than the one used, he was considered to be a "captive rider".

Table 3 shows the different answers to the previous question. Only 15.7 and 23 percentage of the total travellers indicated that they would not use air and automobile travel respectively. However, a very large proportion (45.6%) indicated that they would not travel by bus and this may be an indication of the low public image of this mode. The percentage of travellers who reported that they would never consider using the train was 26.5%. Whatever their reasons are, these travellers do not consider these alternatives as valid choices for themselves.

TABLE 3. Consideration of various modes.

Consideration	Percentages of responses for			
	Air	Automobile	Bus	Train
Will never use it	15.7	23	45.6	26.5
May consider using it	27.6	23	24.8	28.8
Will definitely consider using it	55.1	54	25.8	44.6

Table 4 gives the percentages of captive riders for each mode and purpose category. The percentages of automobile and air travellers who are captive riders are 21.63% and 23.8% respectively. They seem to have strong preferences for their selected mode of travel. The highest percentage of captive riders is for work trips (22.68%) followed by personal business (19.86%), *Aumra* trips (19.4%) and social/recreational (18.62%). Educational/study trips have the lowest percentage (10.13%) of captive riders. Train mode was excluded from this table and from the rest of the analysis because it is available only in one corridor. Totals in Table 4 will not add to 100% because they represent the proportion of captivity of each mode.

TABLE 4. Percentages of captive travellers.

Mode	% of captive travellers by trip purpose					% of captivity by mode
	Work	Personal business	Social/ recreational	Educational study	*Aumra*	
Air	29.18	24.1	19.31	20.68	25.79	23.8
Automobile	19.82	28.28	23.58	11.76	18.77	21.63
Bus	11.69	7.45	9.19	9.09	16.36	12.4
% of captivity by trip purpose	22.68	19.86	18.62	10.13	19.4	

Relationship Between Socioeconomics and Captive Ridership

To study the relationship between socioeconomic variables and the captive ridership, the chi-square test was used. This test was applied to cross tabulations between the variable CAPTIVE (which had the categories captive and non-captive) and the socioeconomic variables. The null hypothesis is that there is no relationship between the CAPTIVE and the socioeconomic variable used. (For more information on this test, the reader is referred to Fienberg[10]).

The results of the chi-square test are summarized in Table 5. Crameri's V statistics range in value between 0 and 1 and gives an indication of the strength of relationship, i.e. the higher the better. It should be noted that the chi-square test

was applied to air, car and bus mode users separately. The cases where the null hypothesis of "no-relationship" was rejected with a confidence level greater than 95% were indicated by underlining the test statistics.

TABLE 5. Test of relationship between intercity ridership and travel-socioeconomic variable.

Variable code Explanation	Chi-square/Significance/Cramer's V		
	Air	Car	Bus
DURT (Duration)	5.593/0.133/.065	4.86/0.18/0.063	2.48/0.48/0.062
DIST (Trip length)	31.57/0.0/0.155@	9.91/0.13/0.090	5.97/.43/0.096±
PURP (Trip purpose)	13.83/.017/.103@	10.88/.054/.094@	6.74/.24/.102
FMLY (Family size)	7.33/.062/.075@	11.77/.008/.098@	3.71/.295/.076
AGE (Age)	37.35/.000/.169@	8.39/.14/.083	7.91/.162/.111
MSTAT (Marital status)	4.92/.027/.061@	.285/.594/.015	.008/.928/-.004
NUMCAR (Ownership car)	11.32/.010/.093@	1.087/.78/.03	18.86/.000/.171@
DLICE (License possession)	66.42/.000/-.225@	1.805/.179/.038	23.45/.000/-.191@
NUMDI (License in a family)	9.65/.086/.086@	13.173/.022/.104@	5.52/.356/.093
OCCUP (Occupation)	14.83/.011/.106@	6.53/.258/.073	12.16/.033/.137
NATION (Nationality)	32.87/.000/.158@	1.646/.896/.037±	33.159/.000/.227±@
EDUC (Education)	5.066/0.079/0.062	20.95/0.00/0.131@	18.017/0.0/0.167@
PERINC (Personal Income)	24.997/0.001/0.138@	10.851/0.145/0.094	18.360/0.01/0.169±
HHINC (Household income)	11.983/0.101/0.096	23.551/0.001/0.139@	23.171/0.002/0.190±@

@ – Cases where null hypothesis is rejected.
± – Some cells have counts less than 5. Chi-square may not be a valid test

From Table 5, it can be observed that there are ten variables which affect captive ridership at least for one mode of travel. These variables are: the number of family members travelling together, age; marital status; driver's license availability; number of family members with driver's license; occupation; nationality; education; personal income; and, household income. Among these, age and nationality seem to have the strongest relationship as they have the highest Cramer's V values. On the other hand, duration of stay, number of cars owned by the family, and household income were not found to have an effect on captive ridership at a level of significance less than 0.10.

Mode-Selection for Intercity Travel by Choice Riders

The selected modes for various trip purpose categories are presented in Table 6. The entries in the cells, from top to bottom, represent cell frequency, cell percentage, row percentage (Row Pct) and column percentage (Col Pct), respectively. Table 6 reveals that mode choices are very similar for work and personal business categories (checking Col Pct). A very high percentage of educational/study trips are made by air and this is because students receive a fifty percent discount on air travel. There seems to be a high preference for bus and automobile for *Aumra* trips in comparison to other trip purposes. The percentage of automobile trips is highest in the social/recreational category. This is as expected because these trips are usually made by other family members and travelling by automobile may be cheaper and more convenient than the alternatives.

TABLE 6. Mode selection by trip purpose.

Travel mode	Descriptive statistics	Trip purpose					
		Work	Personal business	Social recreation	Educational/ study	*Aumra*	Others
Car	Frequency	85	68	493	15	236	59
	Percent	3.36	2.69	19.47	0.59	9.32	2.33
	Row pct.	8.89	7.11	51.57	1.57	24.69	6.17
	Col. pct.	22.91	21.38	47.63	20.27	41.77	34.91
Bus	Frequency	64	83	1.75	9	217	18
	Percent	2.53	3.28	6.91	0.36	8.57	0.71
	Row pct.	11.31	14.66	30.92	1.59	38.34	3.18
	Col. pct.	17.25	26.10	16.91	12.16	38.41	10.65
Air	Frequency	222	167	367	50	112	92
	Percent	8.77	6.60	14.49	1.97	4.42	3.63
	Row pct.	21.98	16.53	36.34	4.95	11.09	9.11
	Col. pct.	59.84	52.52	35.46	67.57	19.82	54.44

Mode selection by household income is presented in Figure 2. This figure indicates that as the household income increases the air mode selection increases and the bus mode selection decreases. Automobiles are used more by mid-income categories (2,500 to 12,500) but their usage is low for low and high income categories obviously for different reasons.

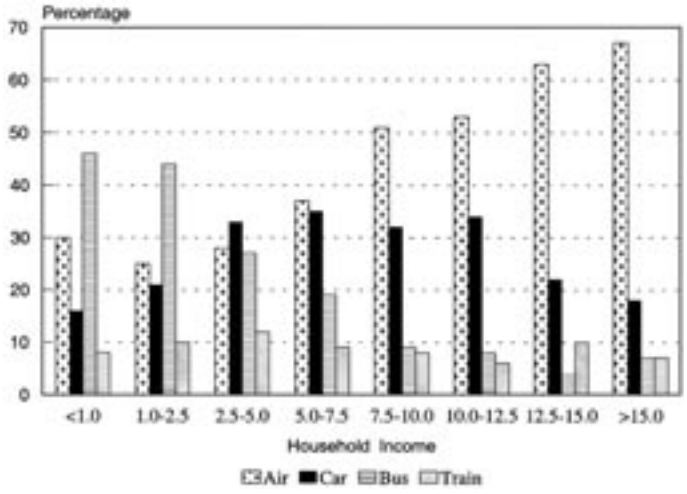

FIG. 2. Mode selection by household income categories.

Mode selection by distance categories is given in Figure 3. This figure shows that the mode share of air travel increases and that of automobile travel decreases as the distance increases. Bus travel choice is not much affected by the distance, indicating that the demand for bus travel is inelastic with respect to distance.

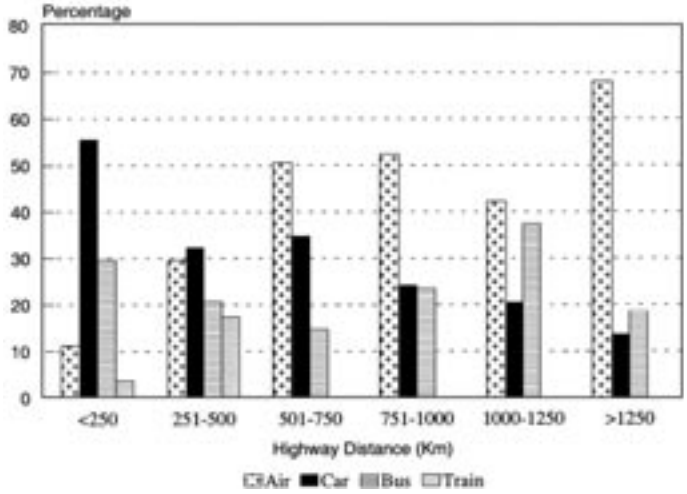

FIG. 3. Mode selection by highway distance categories.

Mode selection by family (or group) size travelling together is presented in Figure 4. The mode share of air and bus travel decreases and the mode share of automobile travel increases with increasing family size.

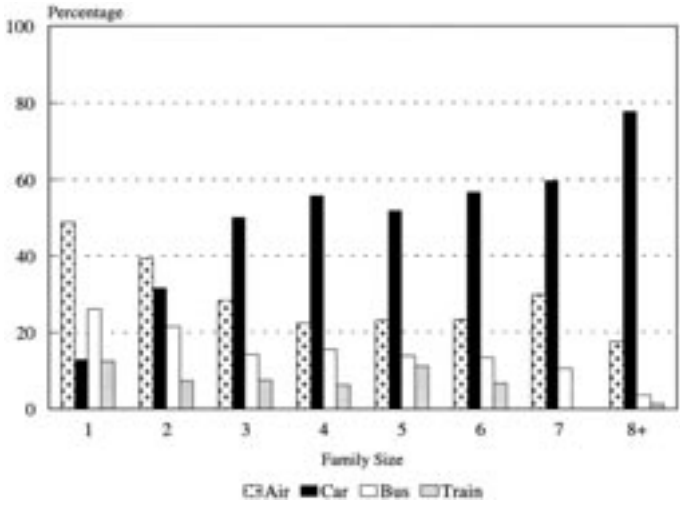

FIG. 4. Mode selection by family size.

The share of air travel seems to increase with increasing automobile ownership as shown in Figure 5. This is probably due to increasing income levels. Bus ridership seems to be affected most by automobile ownership. Around 63 percent of bus riders do not have an automobile. There is a significant drop in bus ridership for travelling owners of one or more automobiles.

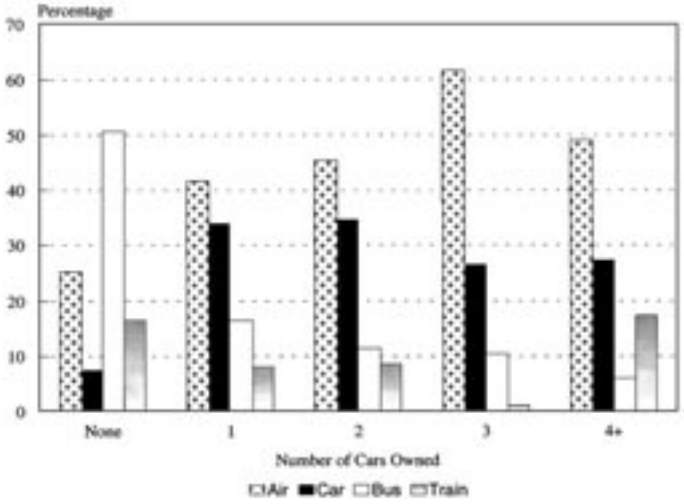

FIG. 5. Mode selection by number of cars owned.

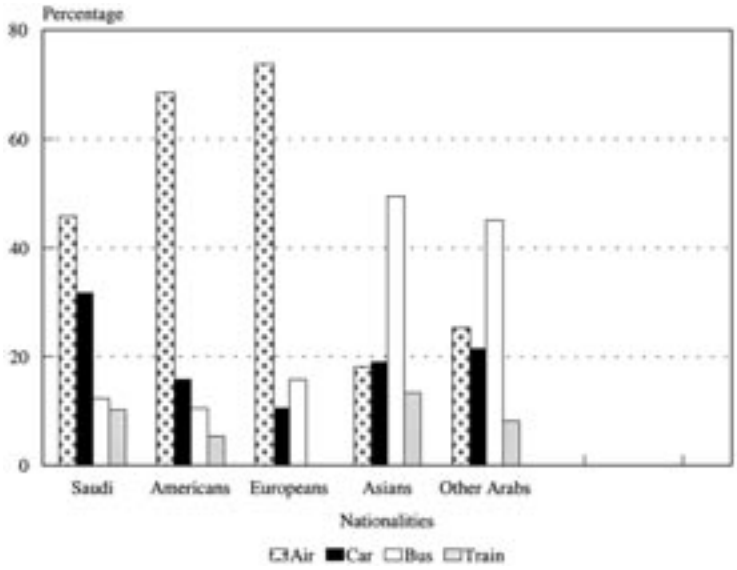

FIG. 6. Mode selection by nationalities.

Figure 6 shows mode selection by various nationalities. This figure indicates that Saudis, Americans and Europeans have a strong preference for the air travel mode. Bus travel is favored by Asians (and Far Easterners) and other Arabs and Africans. Car travel is selected slightly more frequently by Saudis than by the other nationalities.

IV. Conclusions

Following is a summary of the research conclusions:

1. Intercity travel increased in all modes at an accelerated pace during the oil-boom decade of 1972-1982. Following this period, and in parallel with falling oil production and oil prices, the total volume of intercity travel increased only very slightly, 6.2 percent, between 1980 and 1992.

2. The relative shares of air and bus travel have been decreasing during the last decade. This is mainly due to significant improvements in the intercity road network. However, the deterioration of air and bus fleets and their services, together with congestion in air travel, probably played a role in this change.

3. High proportions of automobile and air travellers (21.63 and 23.8% respectively) have been found to be captive riders, i.e. they reported that they would not consider other modes for their particular trip. A very large portion, 45.6% of travelers, indicated that they would not consider bus travel at all for their intercity trips. Apparently, this mode does not seem to have a good image among intercity travelers.

4. Statistically significant relationships among captive ridership and various socioeconomic variables have been found and presented.

5. The preferred travel mode for work and personal business trips seems to be air. Social and recreational trips are shared mostly between air and automobile travel. For *Aumra* trips, a high proportion seems to prefer bus travel, mostly because of organized *Aumra* trips, especially for middle to low income categories. Educational trips seem to have a higher preference for air because of the high discounts available to students in the air mode.

6. Mode choice decisions seem to be affected by travel distance, household income, number of family automobiles, nationality and family size.

Acknowledgement

This research is funded by the National Safety Committee of the King Abdulaziz City for Science and Technology. The authors also wish to acknowledge the support provided by the King Fahd University of Petroleum and Minerals.

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خصائص المسافرين بين المدن في المملكة العربية السعودية

حسن مساعد الأحمدي* ، محمد علي الصغير* و جوكمن إيرجن**

**قسم الهندسة المدنية ، جامعة الملك فهد للبترول والمعادن*

الظهران – المملكة العربية السعودية

***قسم الهندسة المدنية ، جامعة بوجازيسبيك ، إستنبـــول – تركيا*

المستخلص . أصبحت المملكة العربية السعودية من الدول الغنية في العقود الأخيرة مما أدى إلى زيادة مضطردة في الطلب على وسائل النقل بين المدن . وتهدف هذه الدراسة إلى تحديد خصائص المسافرين بين مدن المملكة العربية السعودية وكذلك حصة كل وسيلة من وسائل النقل . ولقد تم تحليل خصائص المسافرين بين المدن وكذلك حصص وسائل النقل من خلال النشرات الإحصائية المعلنة وكذلك البيانات التي تم جمعها من خلال استبانات وزعت على عينة عشوائية من المسافرين في مختلف مناطق المملكة . وقد بلغ عدد الاستبانات المحصلة ٣٥٥٧ استبانة .

وقد أظهرت الدراسة أن هناك علاقة طردية بين الزيادة في دخل المملكة والطلب على النقل ، وكذلك وجد أن هناك ما نسبته ٦ , ٢١٪ من المسافرين مرتبطين بالسفر بالسيارة ، وكذلك نسبة ٨ , ٢٣٪ مرتبطين بالسفر بالطائرة . وتبين أن اختيار وسيلة السفر تعتمد على الدخل السنوي للمسافر ، والمسافة بين المدن ، وعدد السيارات المملوكة للعائلة ، وأعداد المرافقين من العائلة في الرحلة ، وكذلك على جنسية المسافر .