

Modeling travel choice behavior of airport employees for commuting to work at Dubai International Airport, UAE

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Abstract

The aim of this paper is to model airport employees' commuting mode choice at Dubai International Airport (DXB). In addition, the paper models airport employees' willingness for car sharing and discusses the factors that influence them to use public transportation for travelling to their work at the airport, and also presents key considerations for improving the use of this mode share among them. A questionnaire survey was distributed in the airport among employees that contained stated preference and revealed preference questions. A total of 339 airport employees were interviewed and completed the questionnaire. Two models were used; first the Multinomial Logit Model (MNL) was used to model the airport employee's mode choice, and second the Binary Logit Model (BLM) was used to model the airport employee's willingness to car share. The analysis revealed that DXB employees were particularly sensitive to their income, nationality, employment status, car parking permit, and parking reimbursement in making mode choices and that they are not willing to car share.

Keywords: Multinomial Logit Model, Binary Logit Model, travel choice behavior, Dubai International Airport, employees.

1 Introduction: access mode choice decisions

Understanding the key variables that determine access mode choice decisions is subsequently of key significance to airport authorities and transportation managers. Access mode choice has vital implications for different airport management issues. These implications include but are not limited to revenue from car parking and surface transportation services, determination of strategies and



capacity requirements to reduce the share of trips made by private automobile, capital expenditure, and development of landside facilities [1–4].

Airport employees use their private car more often to perform trips. They are characterized by low-level usage of public transportation due to different reasons including dispersed nature of trip origins; their working hours lying outside the times of public transportation operation; perceived reliability, comfort, flexibility, and low cost of the car; as well as the fact that they receive subsidized free parking [5–8].

According to De Neufville and Odoni [9], airport employees perform an average of around 500 single trips on average per annum compared to air passengers taking double the rounds to/from the airport. This proportion can be higher if the airport acts as the base for engineering, maintenance facilities, or headquarters for a large aviation company [5]. These trips are performed by a small number of people compared to air passengers that represent a large number of people each making on average two trips to/from the airport per annum [9–11]. Surface traffic congestion and decrease of the airport access reliability resulted from the rapid urbanization and the growth in the number of vehicle trips on the surrounding road network [11]. Airport employees' schedules are often synchronized with the eight-hour shift pattern in a working day. This creates peak periods of traveler at the changeover of shifts [7, 10].

Several studies examined access mode choice model for air travelers and suggested encouraging them to shift modes and focus on using public transport [3, 12–18]. However, little has been published on airport employee access mode choice model to airports [7]. The focus of this paper is on employees who travel to their work at the airport. This group of travelers was targeted as they contribute significantly to the road congestion due to the use of private modes of transportation. In 2015, 3,197 employees worked at Dubai Airports with 574 Emirati workers (17.9%) and 2,623 non-Emirati workers (82%) [19]. Unlike air passengers, this group of travelers to the airport is clearly distinguished and hence can be more easily targeted for policy actions. This study explores access mode choice of the employees of Dubai International Airport and developed a model to identify and quantify the key explanatory variables affecting the selection of their mode of transportation to travel to it.

2 Methodology and data collection

Modeling airport employees' mode choice requires knowledge of the socio-economic status of travelers and the circumstances of journeys. A revealed and stated preference face-to-face interview survey was designed and conducted by the author exclusively for this study to understand the travel behavior of the airport employees regarding ground access mode choice to DXB. The questionnaire was divided into two parts: one referring to actual events or characteristics for which the revealed preferences were recorded and the other to hypothetical situations for which the stated preferences were recorded. The revealed questions referred to the employee's current main mode and the alternative mode, as well as their socioeconomic characteristics, such as nationality, monthly income, gender,



number of cars they own, occupation and education. On the other hand, stated preference questions were concerned about airport employee's perception of the factors that might encourage them to use public transportation more often, car sharing, and to reduce their private car usage. The survey was randomly distributed on airport employees in the three terminals of DXB. The questionnaire is comprehensive and requires 10 to 15 minutes for completion. A total of 339 airport employees were interviewed and completed the questionnaire. The survey was designed to satisfy the requirements for the development of a ground access mode choice behavior model and to explore the significant aspects, which affect the selection of ground access mode for travelling to work at DXB. The sample frequencies for the chosen mode from this data set are given in Table 1.

3 Statistical results and discussion

3.1 Demographic characteristics

The analysis of the data revealed that among the study sample, only 3.6% were UAE nationals and the rest are expatriates where Asian employees comprise a large proportion of the workers at DXB (40.9% from India, Pakistan, and Filipino). Arab employees from GCC and other Arab countries comprise 21.3% of the total employees working at the airport, and the rest are from other parts of the world. As shown in Table 1, 52.7% of the respondents were males; about 49.3% of the total respondents were aged between 25 and 34 years; 92% of the employees do not have disability; more than 99% finished high school; 73.5% are full time workers and the majority were in professional/manager (34.9%) followed by sales/services (30.4%). In terms of income, 56.7% had monthly income less than AED15,000 (\$4,090 USA), showing a distinctive difference from other monthly incomes; 60.9% of the employees have more than two cars; and 52.8% lives with 4 or more persons in household.

The survey asked the respondents to identify their alternative mode of transportation in their traveling to the airport. Figure 1 shows that most of the employees reported using an alternative mode to commute to the airport and most of them reported that they use their private cars; however, the use of alternative sources of transportation is directly proportional to the usage of cars as either driver or passenger. Those who use car as drivers indicate that their second mode choice would be car but as passengers.

3.2 Factors influencing the usage of public transportation and private automobiles

The questionnaire survey asked respondents about the reasons that would encourage them most to use public transport for their journey to work more and if they already use public transport to get to work, which would they most like to see or think is most important. Information from the survey responses concerning the factors that encourage DXB employees to use public transportation in commuting to their work at the airport is summarized in Table 2. Discount tickets/passes



Table 1: Key socio-economic demographic of the sample.

Total number of respondents						339	
Nationality	Total		337		Total	328	
	UAE		3.6%		None	20.7%	
	GCC		7.1%		1	18.3%	
	Europe		13.6%		2	40.2%	
	North American		5.6%		3 or more	20.7%	
	African		6.5%		Total	326	
	Arab (excluding GCC)		14.2%		1	14.1%	
	India		16.3%		2	17.8%	
	Pakistan		8.6%		3	15.3%	
	Filipino		16.0%		4	32.2%	
Age	Other		8.3%		5 or more	20.6%	
	Total		335		Total	324	
	18-24		15.2%		Full time worker	73.5%	
	25-34		49.3%		Part-time worker	26.5%	
	35-44		28.1%		Total	335	
Gender	45-54		7.5%		Did not finish high school	0.9%	
	Total		332		Finished high school	7.5%	
	male		52.7%		College	18.5%	
	female		47.3%		University	57.3%	
	Total		324		Higher education (Master, PhD)	15.8%	
Disabled	Yes		8.0%		Total	335	
	No		92.0%		Not working	6.0%	
Monthly household income (AED)	Total				General Office	16.7%	
	Less than 5000		19%		Professional/Manager	34.9%	



Table 1: Continued.

Total number of respondents							339		
Monthly household income (AED)	5,000–9,999	18.1%	Occupation			Sales/Services	30.4%		
	10,000–14,999	19.6%				Manufacturing	0.9%		
	15,000–19,999	10.7%				Other	11%		
	20,000–24,999	2.8%				Total	336		
	25,000–29,999	4.6%				Terminal 1	1.8%		
	30,000–34,000	16.9%	Place of work at the airport			Terminal 2	1.8%		
	35,000 or more	8.9%				Terminal 3	94.9%		
						Other	1.5%		

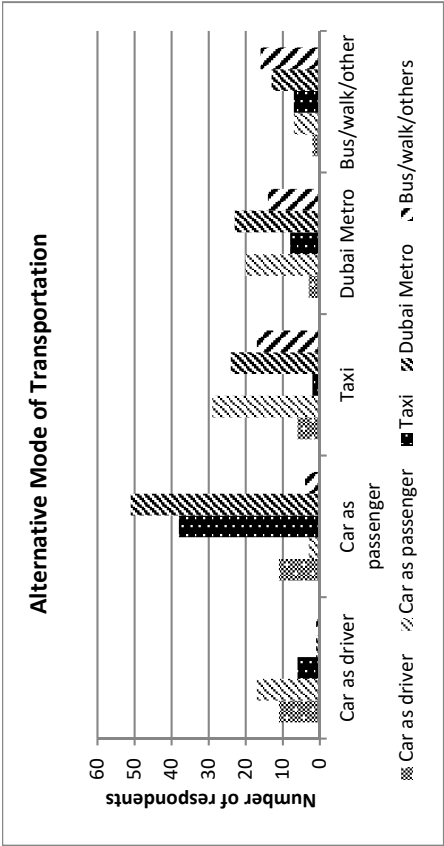


Figure 1: Alternative mode of transportation to commute to DXB.



available at work would be the main factor for 32.8% of the respondents to encourage them to use public transportation. A considerable proportion (17.8%) of the respondents reported that availability of transport at work to enable them to carry out their duties would also encourage them to use public transportation, and 16.6% reported that information on public transportation to help them establish the most convenient route to work will be the main reason that would encourage them to use it. On the other side, 29.4% of the respondents reported that there are no reasons that would encourage them to change their mode choice.

Table 2: Factors that encourage DXB employees to use public transportation in their commuting to their work.

Factors that encourage airport workers to use public transport for their journey to work	Percentage	Factors that encourage airport employees not to bring their car to work	Percentage
Discount tickets/passes available at work	32.8%	Quicker journey by alternative mode	27.3%
Information on public transport, to help me establish the most convenient route to work	16.6%	Cheaper journey by alternative mode	18.7%
Availability of transport at work to enable me to carry out my duties	17.8%	Easier journey by alternative mode	18.3%
Others	3.4%	Airport policy	12.5%
Nothing	29.4%	Health considerations	8.0%
		Social conscience/peer pressure	6.6%
		Lack of airport car parking space	8.6%

The entries clearly demonstrate that transit services are available near employee residences which increase the accessibility to this system and hence can be considered a factor that influences the mode choice and encourages airport employees to use the public transportation system. This also indicates that the public transportation system competes with the convenience provided by the automobile mode of travel in terms of the extent and adequacy.

The questionnaire also asked respondents to report the reasons that would most encourage them to not bring their car to work and if they already don't, what do they think are most important. As shown in Table 2, 27.3% of the respondents reported that quicker journey by alternative mode would most encourage them to not bring their car to work. Cheaper and easier journey by alternative mode was reported by 18.7% and 18.3% respectively and 12.5% reported that airport policy will discourage them of using their cars to travel to their work at the airport.

3.3 Access mode choice modeling using the Multinomial Logit Model

Modeling airport employees' mode choice requires knowledge of the circumstances of journeys and the socio-economic status of travelers. Three alternative airport access modes were identified for access to DXB, namely private car (drivers and passengers), taxi and limousine, metro Dubai and bus system. The



choice set is defined so that the model can be based only on the final modes and neglecting other modes when the journey involves the use of several modes. Therefore, Multinomial Logit model (MNL) is utilized for developing airport access mode choice model. It is assumed in the model that each passenger aims to choose, from a selection available, a travel mode, which has the maximum utility value. The random utility of an alternative i (U_i), is assumed to be:

$$U_i = a_i + b_1x_1 + b_2x_2 + \dots + b_nx_n + \varepsilon$$

where a_i and the b s are the model coefficients, the x s are the values of the explanatory variables. These explanatory variables include the attribute of the alternatives and the characteristics of the trip and the traveler. Assuming that ε_i is independently and identically Gumbel distributed across travelers and alternatives leads to the MNL model:

$$P(i) = \frac{e^{U_i}}{\sum_{j \in J} e^{U_j}}$$

where $P(i)$ is the probability of a decision maker choosing alternative i , U_i and U_j are the utilities of alternatives i and j , and J is the number of alternatives. The utility function for a given alternative is assumed to comprise a deterministic part that consists of a function of measured and observed variables and an error term that accounts for unobserved characteristics across different individuals. In logit choice model, the error term is assumed to be a random variable and the variance of the error term reflects the goodness-of-fit of the model. The deterministic part of the utility function typically consists of a linear combination of explanatory variables with their associate model coefficient, the values of which are determined in the model estimation process. For further details of the derivation procedures, the reader may refer to Morikawa and Ben-Akiva [20] and Train [21]. A discrete choice random-utility model is used to predict airport employees' behavior.

3.4 Modeling car share using the Binary Logit Model

In this study, the Binary Logit Model is used mainly to examine the factors that would encourage DXB employees to car share for commuting to their work. The logit model predicts a categorical variable from a set of predictor variables and it is based on the odds ratio between the variables. One variable must be chosen as a base case and have its coefficients set to zero. It is therefore legitimate, in the binary case, to drop the index i on the coefficient. The logit model in this study express the probability of an individual n to car share to commute to DXB.

$$P_{n1} = \frac{e^{\beta x_n}}{1 + e^{\beta x_n}}$$

The probability of an individual (n) not willing to car share is then $P_{n2} = 1 - P_{n1}$. The maximum likelihood method is used to estimate the coefficients β and their standard errors.



3.4.1 Model results and discussion

3.4.1.1 Modeling employees' mode choice This section focuses on modeling DXB employees' ground access mode choice using multinomial logit model. The explanatory variables used in this model consist of socio-economic variables (income, age, employment status, nationality, number of persons in household, and vehicle ownership) and trip variables (travel time, parking permit, how often travelers use public transportation, car sharing, and reimbursing parking fees). The model was calibrated to examine the behavior of airport employees in accessing DXB. Table 3 shows the results of the model for using private cars (drivers and passengers) and taxis compared to public transportation as different main groups of access mode choice to DXB. In general, the model shows that socio-economic factors including employment status, monthly income, and nationality are significant factors at 0.05 and 0.1 respectively. On the other hand, trip variables that include car sharing and having car parking permit are significant at 0.05 level. Other variables as shown in the table were found not to be significant indicators in the model. The summary of estimations using the multinomial logit model is presented in Table 3. Income, nationality, employment status, car sharing, and car parking permit have substantially contributed to explain the employee's car access mode choice. On the other side, employment status and nationality are the main factors that drive the airport employees to use taxi to travel to the airport. Other factors were found to have no significant contribution to explain the employee's access mode choice. The coefficient for income were positive, which implies that increase in income results in increase in using cars over taxis and public transportation to travel to DXB. The results of the MNL show that an increase for one unit increase in income value, while holding other variables constant, will result in increase of the preference for using the car by 0.379 unit. This indicates that the increase of income reduces the probability of using taxis or public transportation.

The model results show that nationality explains significant access mode choice behavior. Nationality had a statistically significant p-value ($p = 0.001$) for using cars as drivers and passengers and ($p = 0.008$) for using taxis contributing to the explanation of access mode choice. Nationality has a negative sign and hence a negative impact upon choosing car mode or taxis over public transportation. The analysis show that being a United Arab Emirates national would decrease the probability of preferring taxis or public transportation to travel to DXB. On the other hand, being European increases the probability of using taxis and public transportation. In addition, the probability of selecting public transportation increases for nationalities other than being Emirates. The positive sign of the coefficient implies that car parking permit increases the probability of selecting car as the main mode and decreases using taxis and public transportation. In terms of car sharing and its impact on access mode choice, the model shows that as the car sharing increases, the probability of selecting car increases. Employment status is obviously a major factor affecting access mode choice. As expected, travelers who use their own cars as drivers or passengers, or those who use public transportation as their main mode of transportation are more likely to be full time workers.



Table 3: MNL results for modeling employees' ground access mode choice.

Mode of transportation	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)
Car as driver and passenger	Intercept	9.167	2.132	18.481	1	0.000	
	Car parking permit	1.853	0.625	8.778	1	0.003	0.046
	Reimbursed parking cost	0.223	0.298	0.563	1	0.453	0.046
	Car share	0.651	0.372	3.065	1	0.080	0.251
	Age	-0.112	0.230	0.239	1	0.625	0.570
	Gender	-0.431	0.334	1.662	1	0.197	0.337
	Occupation	-0.133	0.184	0.526	1	0.468	0.610
	Number of vehicles	-0.139	0.276	0.256	1	0.613	0.507
	Number of persons	-0.195	0.153	1.635	1	0.201	0.610
	Employment status	1.074	0.452	5.648	1	0.017	0.141
	Time	-0.012	0.257	0.002	1	0.963	0.597
	Nationality	-0.470	0.145	10.536	1	0.001	0.470
	Income	0.379	0.201	3.548	1	0.060	0.985
	Education	0.052	0.236	0.048	1	0.826	0.663
Taxi	Intercept	0.944	2.459	0.147	1	0.701	
	Car parking permit	-0.402	0.822	0.239	1	0.625	0.134
	Reimbursed parking cost	-0.055	0.377	0.021	1	0.884	0.452
	Car share	-0.340	0.478	0.505	1	0.478	0.550
	Age	-0.183	0.247	0.548	1	0.459	0.513
	Gender	-0.036	0.365	0.010	1	0.922	0.472
	Occupation	-0.147	0.209	0.494	1	0.482	0.574
	Number of vehicles	-0.118	0.299	0.157	1	0.692	0.495
	Number of persons	0.047	0.176	0.070	1	0.791	0.742
	Employment status	-0.796	0.412	3.728	1	0.054	0.988
							4.971



Table 3: Continued.

Mode of transportation		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)
Taxi	Time between origin and destination	-0.086	0.294	0.086	1	0.770	0.918	0.515 1.634
	Nationality	-0.422	0.158	7.104	1	0.008	0.656	0.481 0.894
	Income	0.248	0.203	1.494	1	0.222	1.282	0.861 1.908
	Education	-0.131	0.285	0.210	1	0.646	0.878	0.502 1.533

Table 4: Factors which encourage airport workers to car share.

Factors which encourage airport workers to car share	Percentage
Help in finding car share partners with similar work hours	16.6%
Reserved parking for car sharers	15.9%
Reduced car parking charges for car sharers	11.9%
Availability of transport at work to enable me to carry out my duties	13.6%
Other	20.7%
Nothing	21.4%



The survey questionnaire asked respondents if they are willing to car share and what factors would encourage them to do that. In their response, 76% of them refused the idea of car sharing and only 24% are willing to do that. The survey asked the respondents what would encourage them most to car share and if they already share a car to work what would they most like to see. In response to that, 16.6% of the respondents reported that the most encouraging thing to car share is finding car share partners with similar work hours as shown in Table 4, and 15.9% reported that reserved parking for car sharers is the most encouraging factor for car sharing, 13.6% indicated that the availability of transport at work to enable them to carry out their duties is the most encouraging, and 11.9% reported that reduced car parking charges for car sharers encourage them to car share, and 20.7% mentioned that other reasons encourage them to car share. On the other side, 21.4% of the respondents indicated that nothing encourages them to car share.

Table 5 shows different socio-economic and trip characteristics factors that may influence car sharing among the DXB employees. However, among these factors only age and nationality are significant factors at 0.05 and 0.1 respectively and have substantially contributed to explain the employee's car access mode choice. The analysis shows that young workers in the age between 18 and 24 years are the most willing to car share and the oldest between 45 and 54 years old are the least.

Table 5: Different socioeconomic and trip characteristics factors that may influence car sharing among the DXB employees.

Factors	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Gender	0.429	0.319	1.813	1	0.178	1.536	0.822	2.871
Age	0.489	0.229	4.563	1	0.033	1.631	1.041	2.555
Employment	-0.295	0.391	0.572	1	0.450	0.744	0.346	1.600
Number of vehicles	0.093	0.266	0.122	1	0.727	1.097	0.651	1.849
Number of persons	0.095	0.150	0.405	1	0.525	1.100	0.820	1.474
Time	-0.186	0.248	0.559	1	0.455	0.831	0.510	1.351
Nationality	-0.237	0.142	2.805	1	0.094	0.789	0.597	1.041
Income	-0.239	0.188	1.624	1	0.203	0.787	0.545	1.137
Education	-0.067	0.227	0.087	1	0.768	0.935	0.600	1.459
Occupation	0.090	0.177	0.261	1	0.610	1.095	0.774	1.549
Car parking permit	-0.081	0.474	0.029	1	0.865	0.923	0.364	2.337
Mode of transport	0.336	0.189	3.169	1	0.075	1.400	0.967	2.027
Constant	0.500	1.808	0.076	1	0.782	1.648		



4 Conclusion

This study of Dubai International Airport finds that the most important factors affecting DXB employees' mode choice are monthly income, nationality, employment status, car sharing, and car parking permits. The findings of this study can be considered promising to policy makers and airport authority. Unlike many airports around the world that are located in the suburban areas of the cities, Dubai airport is located in the heart of the city which reflects on the airport employees' mode choice when traveling to their work at the airport. The literature indicated that airport employees usually use their private cars as their main mode of transportation to travel to their work; however, this study shows that most of DXB employees use public transportation. This is due to fact that most of those employees live within the city as they need to travel less than 30 minutes to reach to their work. In addition, the public transportation network that consists of Dubai Metro, taxis, and the bus network are robust in the city and can be accessed during the day time. On the other hand, the findings of this study show that DXB employees are not willing to car share. This implies that airport operators need to develop strategies to encourage airport employees to car share to reduce single occupancy trips by car to the airport. For example, the airport authority can encourage employees to car share by reserving the closest and most convenient parking spaces for car sharers which provides some incentive for using ridesharing.

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