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Gender Differences in Work Trip Generation: Evidences from Bangalore

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Abstract

Many of the existing travel behavior models fall short in characterizing the gender differences in transportation. Understanding these differences aids development of sustainable cities typically from a social equity perspective. In this research paper, authors identify a modeling framework to determine the work choice propensity among females in the city of Bangalore. An initial data analysis provides a descriptive variation of the work choice propensity among males and females, and the further regression models elicits the impact of various factors on the work choice propensity of individuals. In the regression framework, the interaction model examines the existence of gendered variation in the influence of various factors, and subsequent models estimates the influence of these factors separately for males and females. The significant impact of the gender incorporated interaction terms in the study reflected the need for gender specific market segment. Further, the stronger influence of social conformation factors on the work choice of women indicated the need for flexible working hours and childcare facilities at work for women. In a developing country context, the study also elicited the role of awareness and educational programs to revamp the societal attitudes, rooted on the patriarchal mind-set, against women's work participation.

*Keywords:*gender difference; work choice; sustainability;trip generation; regression

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1. Introduction

Gender is an important factor that influences the travel behavior of individuals (Simons et al., 2017). Gendered social and economic roles generate differential constraints among men and women in accessing and using transport services. There is a need to develop transportation planning models that capture these differences as it would help in disentangling the complexity in trip making among individuals (Fu, X., Juan, Z., 2017, Asiyanbola, 2010;Oyesiku and Odufuwa, 2002; Oakil et al, 2016). In a city context, this ultimately would assist in planning an equitable, affordable and accessible transportation system in line with the concept of sustainability.

Taking care of household chores and children often dictates a woman's decision to work (Rosenbloom, 1987;Turner and Niemeier, 1997; Su and Bell, 2012; Duchène, 2011). It is more so in many developing nations because of their strong rooting in the familial system where males are considered as the head of the household. Understanding this gendered outlook would help in developing efficient transportation planning models. However, until now, only few studies have attempted to elicit the work choice propensity among females in developing nations. There is a growing need to study the analytical aspects of gendered impacts that can help researchers make improvements (Davison, 2013).

Given the above context, the main objectives of the present study are framed as follow:

- To engineer key socio-demographic factors that affect the work choice among females .
- To determine the existence of a significant gender difference in the influence of these factors.
- To determine the extent of influence of these socio-demographic factors on the work choice propensity of women.
- To analyze the impact of these factors from a policy perspective corresponding to the work choice among women.

The rest of the paper is organized as follows. The next section presents a review of the relevant literature. Section3 focuses on the methodology, section 4 presents a discussion on the results and section 5 concludes the study.

2. Literature Review

This section reviews the significance of the household based approach in travel decision and the influence of these household decisions on the work related travel decision (labor force participation) of a woman.

Many significant decisions concerning an individual are taken at an household level rather than an individual level (Becker,1981). This has been proven true in various significant long term transportation decisions like owning a car (Lerman& Ben-Akiva, 1976) or choice of residential location (Mincer, 1978). However, considering household as a black box that drives decisions often neglect the skewed intra-household power distribution among males and females (Scheiner and Holz-Rau, 2012).Aptly, Katz (1997) highlighted the need to focus on this inequality typically by understanding the intra- household resource allocation. Subsequently, there were studies that explored the intra-household allocations corresponding to the division of labor, time and activities (Baxter, 1997; Kato and Matsumoto, 2009; Wen and Koppelman, 2000). Scheiner and Holz-Rau (2012) classified the reasons for this variation in allocation based on four overlapping hypothesis: economic power hypothesis, social roles hypothesis, preference hypothesis and patriarchy hypothesis.

Historically, females have been found to have preference towards certain set of jobs that include education, health and retail (Waddell, 1996). This preference was governed by their situational characteristics, experiential characteristics and opportunity characteristics (Ekstrom, 1981). For example, situational characteristic like marital status was observed to affect the employment choice of females in Jordan (Peebles et al., 2007), and experiential factor like level of educational was found to impact the work choice in Egypt (Hosney, 2016). According to study conducted in the United States by Hoffman (2009), it was found that marriage is significantly associated with a decline in the probability of participation of women in the labor force. Gunathilaka (2013) and Madurawala (2009) also made similar observations in Sri Lanka.

Accessibility and safety are other important factors that influenced the mobility of women (Fan et al., 2016). Studies have determined a lower private vehicle accessibility and a subsequent lower car ownership rate for women

because of the prevalent social practices that restrained the activities of women (Scheiner and Holz-Rau, 2012; Asiyanbola,2010; Lapotti ,2005; Peters, 2001). For example, in Sweden, 70% of cars on the road were owned by men (Duchene,2011).

Presence of children and elders in the household has also been found to have an impact on the trip generation of married women. A study conducted by Cohany and Sok (2007) in the United States has a revealed a negative impact for the presence of small children at home on the labor force participation of married women. In Malaysia, Ahmad (2007) examined the work-family conflict experienced by 239 married female production operators in dual-career families and concluded that about two thirds of the women intended to leave their job on having a child. The study by Posadas and Fernandez (2012) observed the availability of grandparents' for childcare a significant factor positively affecting maternal labor force participation.

The choice of a woman whether to work or not influenced the trip generation in an area (Hu, 2010). The lower probability among women for conducting an activity outside home influenced the commute trips generated during peak hours in Portland, Oregon (Lawson, 1998). Similarly, in Netherlands and Germany also, childcare and child chauffeuring raised the peak hour commuting in the morning because of the accompanying females (Oakil et al., 2016; Scheiner, 2016). Further, in the United States, females were mostly found to be accompanied by a child in their commute trips, and this increased their time at stops (Kimbrough, 2016). However, in London, gender did not have any significant impact on the trips generated among old women (Schmocker et al., 2004).

India is predominantly a country where families follow a patriarchal system in which women are bound to take care of household responsibilities and men are obliged to take care of financial needs (Dube, 2001). The evolution of this system has a cultural context (Anne et al., 2013), and such a system attaches lot of emphasis on the status of the women linking it strongly with the honor of families. These cultural factors decrease the mobility of women. For example, marriages significantly reduce the job prospects of women (Verick, 2014). A study conducted on working women of Chandigarh revealed that only one third of the women retained the same job after marriage (Kaur, 2012). In general, the percentage of females in the total labor force, in both urban and rural areas, has decreased from 29.5% in 2005 to 27.14 in 2014 (World bank, 2016; Sanghi et al., 2015). Two other reasons attributed to this decrease was the increase in average household income that reduced women's participation in subsidiary activities and lack of accessibility among women to their preferred jobs (Verick, 2014; Sankaran and Madhav, 2011).

3. Methodology

3.1. Data description

Revealed preference data obtained using household travel survey of the city of Bangalore, for the year 2009, is used in the study. Bangalore has a population of 10.8 million (Comprehensive Traffic and Transportation Study for Bangalore, 2010) and has an urban area of 2191km2. The travel survey data was obtained from the secondary source of Bangalore Metropolitan Regional Development Authority (BMRDA). The survey adopted a random sampling procedure, and checked the sample representation over the target population. Household was the sampling unit, and the sample incorporated 2.1 % of the total number of households in Bangalore. The details of primary surveys and data representability are reported in the Field Survey Report of BMRDA (Comprehensive Traffic and Transportation Study for Bangalore, 2010). The present study used household data from the entire 172 zones from the urban area of Bangalore.

Household Information was collected on the attributes of trip-maker, mode, and trip using face-to-face interviews. Factors including gender, age, occupation, level of education, marital status, income, vehicle-ownership level, number of earners, type of residence, in vehicle travel time, mode used, purpose, and travel distance were collected. Table 1 presents the sample characteristics for females obtained from the study area.

Table 1. Sample characteristics of females in the study area

Variables	Variable categories	Percentage in sample
Age	Less than18 years	21.4
	18-55 years	73.7
	Greater than 55 years	4.87
Occupational status	Employed (Part time and full time)	8.1
	Self employed	1.1
	Daily wages	1.5
	Student	12.1
	Home maker	74.5
	Retired and others	2.8
Education Level	Illiterate	27
	Up to Higher secondary school	43.6
	Up to Senior secondary school	17.6
	Technical diploma	2.1
	Graduate and above	8.9
Male household head	Yes	0.88
	No	0.12
Has a driving license	Yes	8.3
	No	91.7
House hold level vehicle ownership	0	47.8
	1	42.2
	2	7.2
	3 and above	2.7
Marital status	Married	73
	Unmarried	37

3.2. Methodology

Figure 1 shows the flow chart for methodology adopted in the current study. The first step consisted of estimation of major variables indicating the gender variation through previous literature and expert opinion. The next step consisted of a descriptive statistical analysis using a two-sample test to elicit the existence of a significant difference between the characteristics of males and females. In the third step, individual work choice models were developed using regression, where in, an initial interaction model was developed based on which subsequent female and male work choice models were determined.

The two-sample significance test checked the existence of a significant difference between the percentages of males and females in the subgroups of different variables. Here, the null hypothesis assumed that the percentage of males was similar to the percentage of females, and the corresponding alternate hypothesis assumed that the percentages were different. The null hypothesis was accepted if the P-value was greater than or equal to 5%, and the null hypothesis was rejected if the P-value was less than 5%.
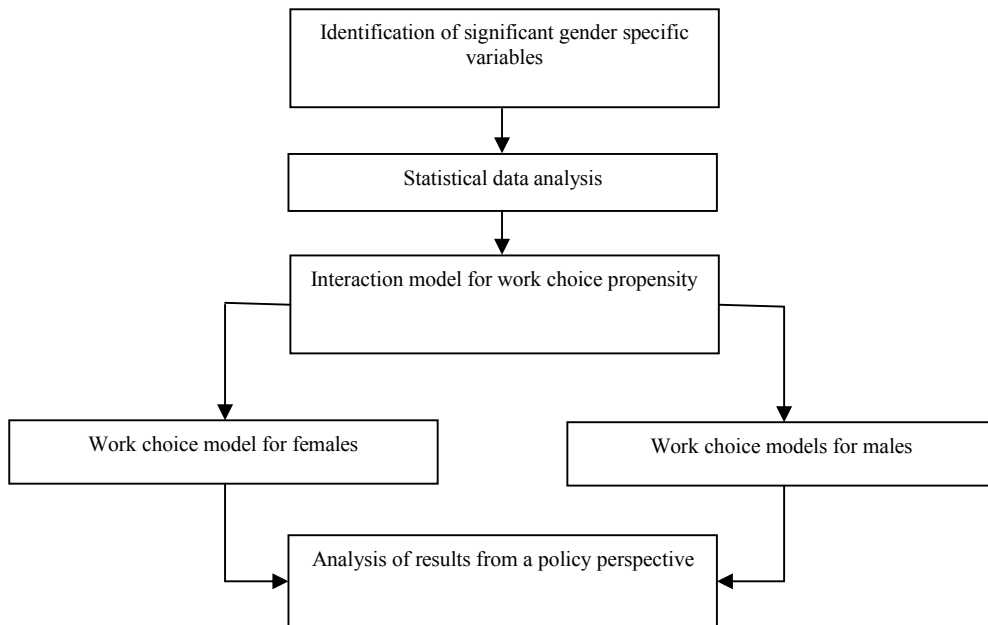
Fig. 1. Flow chart of methodology

Logistic regression model, a class of generalized regression model, was used to determine the impact of different variables on the work choice. Generalized linear models predicted the conditional mean of a dependent variable or some function of the conditional mean, using a linear function determined for a set of independent variables. The canonical parameter logistic regression model is defined as

$$\ln\left(\frac{P_n}{1-P_n}\right) = \beta_0 + \sum_{k=1}^{k} \beta_k X_{nk} \qquad (1)$$

K= number of unknown parameters
X = variables influencing the probability
P_n = probability of success for individual 'n'
β = Parameters which can be estimated using maximum log likelihood

Table 2 presents a list variables used in the study along with their description. Variables including marital status, children below 5 years, children below 18 years, individual above 55 years, male household head, driving license, and person household head were dummy variables. The table groups the variables that are indicative of gendered differences based on the hypothesis classification mentioned by Scheiner and Holz-Rau (2012) - the economic power hypothesis (economic power distribution), social roles hypothesis (Social role conformation), preference hypothesis (Attitude) and patriarchy hypothesis (Patriarchy). Socio-demographic variables constitute the control variables in the model.

Table 2. Description of independent variables

Variables	Description	Variable class
Age	What is the age of the individual	Socio-demographic
Marital Status	Whether the individual is married or not 0.No 1. Yes	Social role conformation
Education Level	What is the education level of individual 1. Illiterate, 2.Up to senior secondary school, 3. Up to Higher secondary school, 4.Technical diploma, 4.Graduate and above	Socio-demographic
Children below 5 years	Whether there is a child under the age of 5 years in the household 0.No 1. Yes	Social role conformation
Children between 5- 18 years	Whether there is a child between 5-18 years of age in the household 0.No 1. Yes	Social role conformation
Individual above 55 years	If there is a person above the 55 years of age 0.No 1. Yes	Social role conformation
Male household head	Whether the head of household is male or not 0.No 1. Yes	Patriarchy
Person household head	Whether the person is head of the household 0.No 1. Yes	Attitude
Monthly household income	What is the monthly income of the household	Socio-demographic
Driving license	Whether the person possess a driving license 0.No 1. Yes	Attitude
Number of motorized private vehicles	The total number of motorized vehicles in the household (cars, two – wheelers, etc.)	Economic power distribution

4. Results and discussions

4.1. Data Analysis

Table 3 shows a comparison between the male and female work choice propensity across various factors. The p-value corresponds to the two-sample test for proportion, and it is significant across all the factors. In the table, number of people who were working in the employable age of 18-55 years was higher for males. However, the proportion of working females spiraled upwards with increase in educational status compared with males. This indicates a possible need for education of females to propel their job prospects. Marriage affected the work choice of males and females in a contrasting manner. Getting married improved the number of working males but decreased the number of working females. In an Indian Scenario, marriage could be considered as an indicator of social role conformation among females. Female perception, right from childhood, is shaped based on the concept of husband earning for the family after marriage while wives take care of the household chores. Similarly, for females, having a male household head and not having a driving license reduced the job prospects. The observation that having a male house hold significantly reduced the job participation of women in that household compared with households that were not having a male head clearly indicate the existence of a patriarchal mindset.

The results of the table emphasizing a higher work choice propensity for males compared with females across all

the factors gave a preliminary indication of difference in their work choices. There might be many reasons for this difference including the factors representing the hypothetical scenarios as mentioned by Scheiner and Holz-Rau (2012). However, in general one could assume that the lower preference among women participating in a job might be a result of a confluence of various factors that are representative of male dominance in the study area.

Table 3. Percentage of working individuals among males and females

Variables	Variable categories	Percentage of males working	Percentage of females working	P-Value
Age	18-55 years	86.1	17.3	0.00
	Greater than 55 years	81.9	26.9	0.00
Education Level	illiterate	84	18.7	0.00
	Up to Higher secondary school	89.4	19.9	0.00
	Up to Senior secondary school	89.3	20.7	0.00
	Technical diploma	90.8	27.5	0.00
	Graduate and above	90.8	36.7	0.00
Whether there is a child under the age of 5 years in the household	Yes	93.8	19.1	0.00
	No	94.2	23.2	0.00
Has a driving license	Yes	94.8	66.5	0.00
	No	85.3	20.1	0.00
Marital status	Married	91.7	13.9	0.00
	Unmarried	80.5	42.2	0.00
Male household head	Yes	94.9	19.7	0.00
	No	87.3	42.9	0.00

4.2. Regression

Table 4 present the results of regression for determining individual work choice propensity. The adjusted rho-square values obtained for the interaction model, and for models of females and males were respectively 0.481, 0.427 and 0.558. The rho-square values were indicative of the improvement in the model fit. It varies from zero to one, where in a value of zero represents a poorly fitted model and a value of 1 represents the best fitted model. The likelihood ratio tests gave p-values less than 0.05 for all the models, and it indicated the existence significant impact of independent variables on the work-choice propensity.

Variables representing interaction of gender with different independent factors added a significant predictive capability to the interaction model. The loglikelihood ratio test between the models with and without interaction terms estimated a statistical P-value less than 0.05(chi-square value of 94.42 with 4 degrees of freedom).This effect of interaction variables supported the estimation of separate models for males and females. The segregation of data in to different market segments would take care of the differential impact of various independent variables across the market segments.

Presence of children below 5 years in a household reduced the work choice probability of females in that household. This was similar to the findings of Ahmed (2007) and Scheiner (2014). According to the study done by Scheiner (2014), birth of a child and labor force participation were two important events that affected the trip making behavior in Germany.

On the contrary, if the child is aged between 5-18 years, the work choice probability of females increased. This increase might be a result of attainment of self-sufficiency among older children thus enabling a female to opt for a job. Gunathilaka (2013) showed that, in Sri Lanka, the likelihood of a woman joining the labor force increased by 2 percent after their children attained self-sufficiency.

The estimated parameter value for age in the models for males and females was insignificant. The result

obtained was not in accordance with the results of Rosenbloom and Raux (1985).

Table 4. Results of regression.

Independent variables	Estimated coefficients (P-Value)		
	Interaction model	Females	Males
Alternate specific Constant	-2.73(0.00)	-1.50(0.00)	1.16(0.00)
Age	0.00218(0.49)	0.00385(0.29)	-0.015(0.00)
Marital Status	-	-0.762(0.00)	0.542(0.00)
Education Level	0.322(0.00)	0.352(0.00)	0.0817(0.01)
Children below 5 years	-	-0.315(0.01)	-
Children between 5- 18 years	-	0.235(0.00)	-0.122(0.14)
Individual above 55 years	-	0.240(0.01)	-
Male household head	-	-0.789(0.00)	-
Person household head	1.58(0.00)	0.928(0.00)	1.37(0.00)
Driving license	1.95(0.00)	1.74(0.00)	0.788(0.00)
Number of private vehicles	0.143(0.00)	0.143(0.00)	-
Gender	3.90(0.00)	-	-
Gender x Age	-0.0111(0.01)	-	-
Gender x Education Level	-0.250(0.00)	-	-
Gender x Person household head	-0.0679(0.63)	-	-
Gender x Driving license	-1.15(0.00)	-	-
Marital Status x Education Level	-	-0.149(0.01)	-
Male household head x Monthly household income	-	0.0586(0.38)	-
Number of individuals:	13213	6155	7058
Null log-likelihood:	-9158.554	-4266.321	-4892.233
Final log-likelihood:	-4747.760	-2431.337	-2153.615
Rho-square:	0.482	0.430	0.560
Likelihood ratio on comparing model with and without interaction variables	94.42 (4 degrees of freedom)	6.28 (2 degrees of freedom)	-

Presence of people above 55 years in the household had a positive effect among females to generate a trip for work. This may be because of the availability of this elderly group for taking care of the household in the absence of women. In Indian cities, one could observe a scenario where in older parents summoned by their children to take care of the formers grand children. Availability of elderly persons for performing household chores and looking after children has been determined as a significant factor affecting maternal labor force participation (Posadas and Fernandez, 2013).

The factor "whether the head of household is a male' was intended to reflect patriarchy that represented a woman's rather ineffective position in negotiating within a household (Scheiner and Holz-Rau, 2012). Among households with similar income, the head of household being a male reduced the chances that a female from that household would make a work trip. This indicated an unequal gendered power distribution in the household decision making as observed by Ekstrom (1981). However, the model indicated a reduction in the negative influence of 'male head of household' with increase in income. This was observed from the positive value for their interaction variable in the model.

Among females with same marital status, education had a positive impact on the work choice propensity. However, as can be inferred from the negative value of the interaction term, the extent of impact of education on the work choice propensity became weaker among married females. Even though education increased the job participation of woman, marriage reduced this impact of education. With the impact of social conformation corresponding to childcare and patriarchy corresponding to the impact of male household head being taken care of, this effect of marital status may be attributed to the effect social perception that females are also supposed to take care of household chores other than childcare. The results indicate how strongly rooted social values can undermine the effect of education. The result obtained was similar to that observed by Hoffman(2009) in the United States and Cunningham(2001) in Mexico.

Female's being the head of the household increased the chances of a woman from that household undertaking a work trip. One reason for this positive impact may be the positive outlook of that family towards woman participation in a job. It is not illogical to believe that households with a female head generate a positive attitude towards jobs among females of the family. Ekstrom (1981) had associated the negative attitude among females to

the fear of failure that was a byproduct of the male dominated society. This fear of failure could be overcome among females by maintaining a positive attitude.

Among households having either a male or a female head, there was decrease in the work choice propensity among women with increase in household income. This was in accordance with the observation made by Ekstrom (1981) that women are less likely to work if the financial status of the family is better. However, it contradicted the observation of Malhotra and De Graff (1997) that in Srilanka employed males provided a social capital that helped women locate a job.

Owning a driving license and an increase in the number of private vehicles at home increased the job participation of women. Both these could be considered factors that improved the accessibility of women to private vehicles in a household. Having a private vehicle would reduce the travelling time to a destination. Further, private vehicles are also safe and comfortable from a women's perspective.

5. Conclusion

The present study analyzed the gendered effect of various elements on the work choice propensity of individuals in the Bangalore city. The study initially gathered information regarding various factors influencing the mobility of women, and then performed data analysis and regression modeling to elicit the impact of these variables on the work choice probability. Certain important policy implications that were elicited from the study are as follows.

- There is a significant difference in the factors influencing job participation between the males and females. This was evident from the results of the interaction model that determined a significant influence for the market segmentation based on gender.

- Among married women, a higher educational status was increasing their inclination towards a job. In many developing countries, the educational status of women is not in par with that of men (Adeel et al., 2016). Education has been has been globally accepted as an important tool for the empowerment of women. Attaining education will generate a positive mentality among women towards being an earning member in the family. It would help them in understanding the general notions of the social conformation rules that has been historically set.   In India, the government has initiated various programs and policies like "SarvaShikshaAbhiyan" and "Saakshar Bharat" to ensure educational opportunities for women in adolescence and adulthood. Education would inculcate a critical thinking among women and that may lead lead them to decide the best option for themselves. In addition to job participation, education would also help in a societal perspective to promulgate ideas of cleanliness, hygiene and various other aspects that may help in the general well being of the family.

- There is a need among women to achieve a balance between work and household responsibility like taking care of children. From an activity modeling perspective, it may include providing flexible working arrangements that allow female parents to manage their time and responsibilities. Flexible job timings, working from home and child care facilities at work places are certain arrangements that may help women in fulfilling their dual roles in a household - as caretakers of children and as economic contributors. Flexible working times to an extent may help woman to manage their dual roles a homemaker and earning member. Providing childcare facilities like a day care may immensely help a woman in accompanying their children, which might be an additional burden if the childcare facility is located at a far-off place.

- The elements of patriarchy in a developing country context decreased the tendency to generate a work trip among women. Transforming social attitudes against women going for work by changing the patriarchal mindset of the society through awareness and educational programs may improve the probability of women going to work. A concerted effort is needed in this aspect. It many times involves educating not just woman but also a man regarding the role of a woman in the society. Even though, patriarchy may be a by product of various other factors other than an ignorance among society, awareness through education may be considered as a factor that can significantly influence its effect.

The current study also provides scope for future expansion. Determination of the impact gendered factors on the

travel behavioral aspects like mode-choice and trip distance can be further expected to expand our knowledge regarding the role of gender in travel behavior modeling.

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