



A JOINT HOUSEHOLD-LEVEL ANALYSIS OF WORK ARRANGEMENT DECISIONS OF INDIVIDUALS

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INTRODUCTION

- Work activities generally act as a peg around which other non-work activities of an individual are scheduled.
- Activity-based models of travel demand focus on analyzing the work-related decisions of individuals before generating other non-work activity episodes and their spatial/temporal attributes.
- Work-related decisions of one adult are not likely to be independent of the work-related decisions of other adults in a household.
- More important today → individuals seeking more work-family balance → the market place is responding through increased opportunities for part-time jobs, self-employment, and home-based work (see Bureau of Labor Statistics, 2011)

EARLIER STUDIES

- Current models of employment choice examine work decisions at an individual-level
- Consider only individual and socio-demographic variables
- Most of these studies do not consider the built-environment variables (except for few studies which modeled Telecommuting behavior)
- A Classification Taxonomy and Empirical Analysis of Work Arrangements, Yeraguntla and Bhat (2005)
- Labor Force Participation, Gender and Work in South Africa: What Can Time Use Data Reveal? , Floro and Komatsu (2010)

CONTRIBUTIONS OF THE CURRENT STUDY

- Jointly model the work arrangement decisions of all adults (older than or equal to 16 years) in a household
 - Common observed and unobserved factors affecting the different work arrangement decisions of the same individual
 - Common observed and unobserved factors affecting work arrangement decisions across individuals
- For each adult in the household, we model five dimensions characterizing work arrangement
 - **Employed or not**
 - **Self-employed or not**
 - **Full time or part time**
 - **One or more jobs**
 - **Home-based worker or not**

METHODOLOGICAL CONTRIBUTION

- Each of these dimensions is modeled as a binary choice
- Selection process at work
 - Last four of the dimensions are conditional on a positive employment decision
- Multivariate binary probit form (with selection) with the total number of dependent variables being $5*Q_h$, where Q_h corresponds to the number of adults in household h
- The multivariate probit system → much more efficient than the alternative of forming “package” alternatives of the work dimensions across individuals and using a nested logit or multinomial probit model

ILLUSTRATION

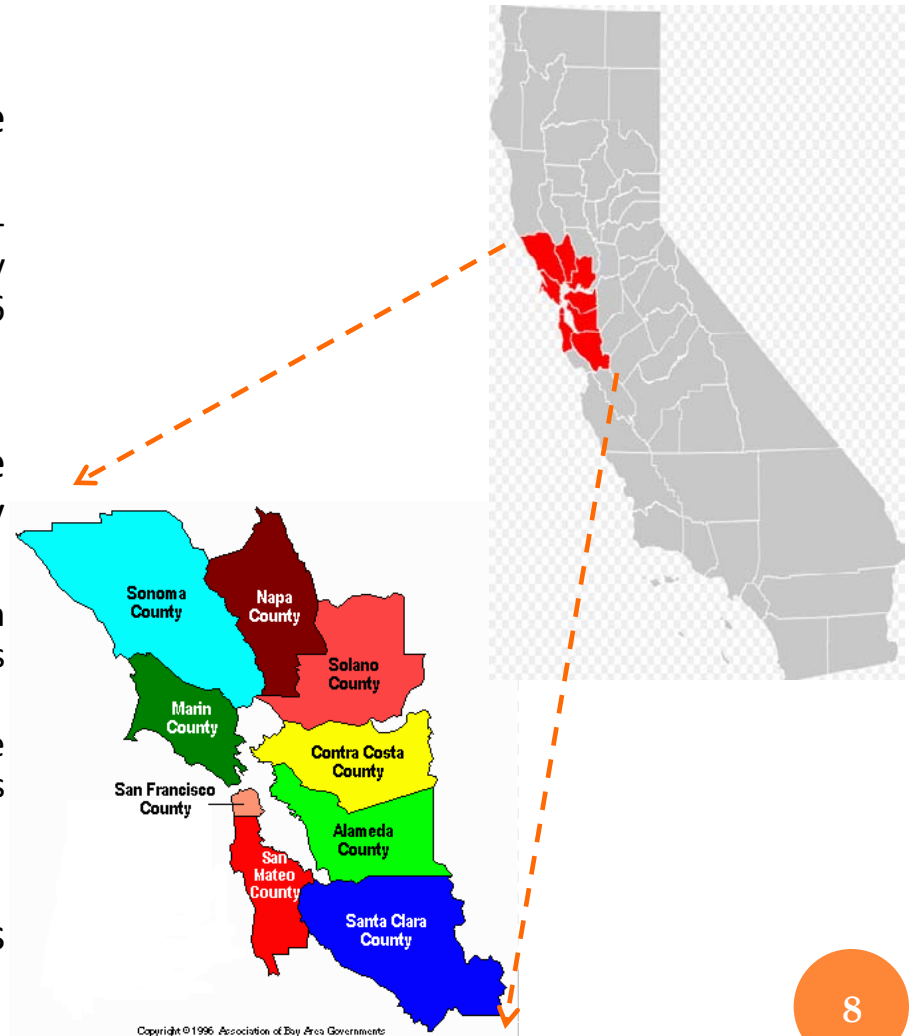
- Latter structure → the number of “package” alternatives explodes quickly
- 3 adults in a household
- Total number of alternatives is $17^3=4913$,
- Multivariate probit system → just 15 dependent variables
- Our modeling approach enables
 - Estimation with a limited number of model parameters
 - Allows easy interpretation

ESTIMATION METHOD

- Log-likelihood evaluation involves evaluating multi-dimensional integral
- Can be very expensive either when a household has many eligible individuals to be employed
- Simulation methods have convergence problems
- Estimated using a Maximum Approximated Composite Marginal Likelihood (MACML) estimation approach (Bhat, 2010)

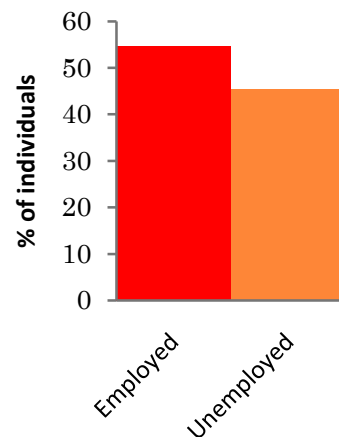
DATA

- 2009 NHTS data → ideally suited for the current study
 - Collected employment and other socio-demographic information of nearly 270,760 adults (older than or equal to 16 years) in 308,901 households
- Focus specifically on the NHTS sample corresponding to the San Francisco Bay area.
 - Research team already has developed an extensive set of built environment measures for the Bay area
 - California add-on data of the NHTS sample has Census Tract in which each household is located → used to merge the BE measures
- The Bay area NHTS sample includes 3808 households

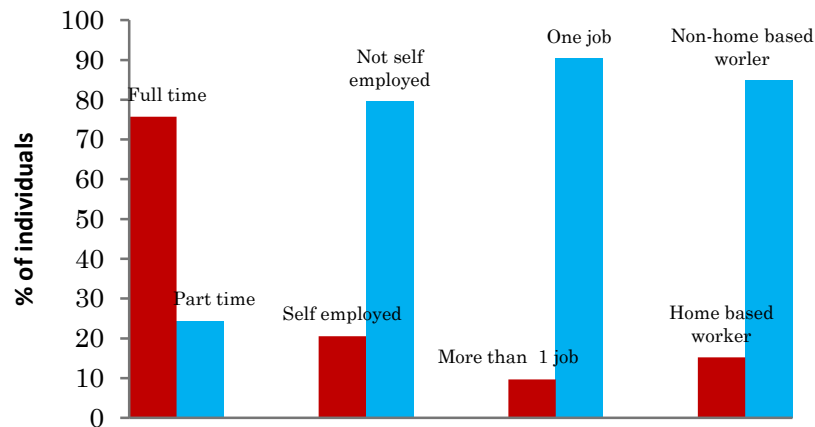


DEPENDENT VARIABLES

- Individual of age 16 or over are considered for the analysis.
- Final sample → 5,364 adult individuals from 2874 households
- 2,929 individuals (54.6%) are workers, while 2,435 individuals (45.4%) are non worker
- 2,218 individuals (75.7%) worked on a fulltime basis, while 711 individuals (24.3%) worked on a part time basis
- A total of 600 individuals (20.5%) are self-employed
- 284 individuals (9.7%) have more than one job
- 444 individuals (15.2)% are home-based workers



Work Arrangement



BUILT ENVIRONMENT MEASURES

- *Land use structure and mix measures* → fraction of retail, residential, and open land use, land use mix, fraction of single family and multi-family dwelling units
- *Demographic mix measures* → mean household size, mean household income, mean income in each income quartile, fraction of population aged 62 years or more, fraction of population by different ethnicities and races
- *Employment density measures* of different industries → retail trade, service, agriculture, manufacturing, wholesale trade
- *Activity intensity measures* → density of eat out, recreational, religious, retail, and maintenance activity centers, density of schools
- *Local street network measures* → density of bikeways and highways, street network grain size defined as number of street blocks per square mile, connectivity index defined as ratio of number of nodes to links in the roadway network, percentage of cul-de-sac streets
- *Network level accessibility measures* → Hansen type accessibility measures by different employment types, number of zones accessible by transit, mean walk access time to bus stops, number of zones accessible by walk, bike, and transit within certain time (5, 10, 15, and 20 minutes)

BUILT ENVIRONMENT MEASURES

- All the BE measures constructed at the traffic analysis zone (TAZ) level for year 2000
- Two issues
 - SF Bay area migrated to a finer TAZ system with 1454 zones in the year 2007 from the year 2000 TAZ system with 1099 zones
 - California add-on dataset that the researchers have access to provided only the household census tract in which the household lies (and not the TAZ)
- Constructed a TAZ1099-TAZ1454-Tract correspondence file using the information available on the website of Metropolitan Transportation Commission
- We then used BE measures corresponding to the year 2000 TAZ for all the tracts that mapped back to the same TAZ.
- In most cases, there is a one-one mapping in the correspondence file between the census tract and TAZ
- In cases where census tract belonged to more than one TAZ, BE measures are obtained as the average of the BE measures of all the TAZs corresponding to the census tract

EXPLANATORY VARIABLES

- The final data used for the analysis has 3335 households
- Individual Socio-demographic Characteristics
 - Gender
 - Age (16 yrs ≤ age ≤ 25 yrs, 26 yrs ≤ age ≤ 40 yrs, 41 yrs ≤ age ≤ 60 yrs and age > 60 yrs)
 - Marital Status (married vs. not married)
 - Driver status (driver or not)
 - Race (Caucasian, Hispanic, Asian, African-American, Multiracial, Other)
 - Education level (high school graduate or less, college degree, bachelor degree, and graduate degree)
 - Job category (sales/service, clerical/admin support, construction/farming, professional/managerial/ technical)
 - Presence of a medical condition that makes the individual hard to travel
 - *Immigration Status*
 - Indicator variable for whether the individual is immigrant
 - Number of years since the individual came to United States

EXPLANATORY VARIABLES

- Household Socio-demographic Characteristics
 - Household income (income < 30k, $30k \leq \text{income} < 75k$, and income $\geq 75k$)
 - Housing unit own or rented
 - Presence of children (below the age of 16),
 - Presence of senior adults (age 65 or above)
- BE measures

KEY RESULTS: EMPLOYED OR NOT

○ Individual Demographics

- Female individuals are less likely to be employed compared to male individuals in households with no children
- Male adults are more likely to be employed if the household has children less than 16 years of age while women adults in households with children are less likely to be employed
- Individuals in the age group of (26 yrs ≤ age ≤ 60 yrs) are most likely to be working.
- Young adults (16 to 25 years) are the least likely to be employed. However, young adults who are drivers are more likely to work than old adults
- Individuals with college degree or higher level of education are more likely to be working compared to individuals with high school graduate or less education.
- Caucasians are more likely to be working than non Caucasians.
- Immigrants are less likely to be employed compared to native people. However, as the number of years that the immigrant household has been living in US increase, he is more likely to get employed

○ Household Demographics

- Individuals in household with senior adults are less likely to be workers
- Individuals in household with children are more likely to be workers

KEY RESULTS: SELF EMPLOYED OR NOT

○ Individual Demographics

- Individuals with college degree or higher level of education are appear to be more likely to be self-employed
- Employees in manufacturing, construction, maintenance, or farming and sales, service occupations are more likely to be self employed than other occupation types (such as managerial and clerical).
- Immigrants are less likely to be self-employed. However, as years of stay in US increase the chances of getting self employed also increase → Assimilation

○ Household Demographics

- Individuals belong to high income households are less likely to be self-employed

○ BE Measures

- Individuals in households located in urban locations are more likely to be self-employed
- Higher the population density of the home TAZ, less likely to be self employed
- Higher the accessibility to employment less likely to be self-employed
- However, higher the accessibility to shopping centers → more likely to be self-employed.

KEY RESULTS: FULL TIME OR PART TIME

○ Individual Demographics

- Married male is more likely to be full-time employed where as married woman in households is more likely to be part time worker
- Female individuals in households with children are more likely to be part time workers
- Young adults (16 yrs ≤ age ≤ 25 yrs) in households are least likely to be full-time worker
- Individuals with college degree or higher level of education are more likely to be full time worker
- Caucasians and African American are more likely to be part time worker than other races (Asian, Hispanic, Multiracial and other races)
- People having a medical condition which makes it difficult to travel reduces are more likely to work part time
- Immigrants are more likely to be full time employed. However, as years of stay increase the difference between immigrants and non-immigrants reduces

○ Household Demographics

- Individuals in household with senior adults are less likely to be full time workers

○ BE Measures

- Higher the population density of the home TAZ, more likely is the individual in that household to be full time employed

KEY RESULTS: MORE THAN ONE JOB OR NOT

○ Individual Demographics

- Young adults (16 yrs ≤ age ≤ 25 yrs) in households are more likely to have more than one job compared to other adults (age ≥ 26 yrs)
- Individuals with college degree or higher level of education are more likely to have more than one job compared to individuals having less than college degree.
- Caucasians and African American are more likely to more than one job compared to other races (Asian, Hispanic, Multiracial and other races)

○ Household Demographics

- Individuals in high income households are less likely to have more than 1 job

○ BE Measures

- Individuals in rural areas are more likely to take up multiple jobs

KEY RESULTS: HOME BASED WORKER OR NOT

○ Individual Demographics

- Individuals with bachelor degree or higher level of education are more likely to be home-based worker compared to individuals having less than bachelor degree.
- Employees in managerial, technical/professional, and clerical occupations are less likely than other occupation types (such as sales/services and production/construction etc) to work from conventional work-hour arrangements.

○ Household Demographics

- Individuals in high income households are less likely to have more than 1 job

○ BE Measures

- Individuals located in TAZs with high density of recreation centres are more likely to be home based workers
- High accessibility to recreational facilities also increases the probability of working from home
- Individuals in TAZs with high average household income in home TAZ are more likely to work from home

KEY RESULTS: JOINTNESS OF WORK ARRANGEMENT DECISIONS OF SAME INDIVIDUAL

	Employed or not	Self Employed	Full time	More than 1 job	Home based worker
Employed	1				
Self Employed	0	1			
Full time	0	-0.359	1		
More than 1 job	0	0.2906	-0.2164	1	
Home based worker	0	0.8024	-0.3134	0	1

KEY RESULTS: JOINTNESS OF WORK ARRANGEMENT DECISIONS OF ALL INDIVIDUALS IN HOUSEHOLD

Jointness of work arrangement decisions accounted by estimating generic covariance matrix of the household level heterogeneity terms in each of the work arrangement decisions

	Employed or not	Self Employed	Full time	More than 1 job	Home based worker
Employed	0.1267				
Self Employed	0.2657	0.3658			
Full time	0	0	0.1293		
More than 1 job	0	0	0	0	
Home based worker	0.1649	0.3045	0	0.1018	0.3549

CONCLUSION

- Modeled different work arrangement decisions of each individual jointly
- Accounted for common observed and unobserved factors that influence work decisions of all individuals in household
- Evaluated the impact of comprehensive set of BE measures → policy analysis
- Examined the impact of host of individual and household level demographics including immigration status → can be applied to predict the impact of changing demographics over time
- Future efforts
 - Compute the elasticity effects using the joint model and independent model systems to better understand the results
 - Consider residential location self-selection effects

Thank You

