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Impact of Personal Factors on Lack of Adequate Transportation Access

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Transportation has a significant role in our everyday lives. However, there are still many people that struggle to find a consistent source of transportation. The Louisville Urban League, a program that helps marginalized groups gain social and economic equality, took a survey of young clients ranging from ages sixteen to twenty-five where many of them listed not being able to secure stable transportation as a top three need. A lack of secure transportation access can be detrimental to peoples' lives in many ways such as an inability to be employed, go to school, or get medical help along with other needs people have that require transportation. Therefore, it is important to develop a deep understanding of the root causes of a lack of adequate transportation. The purpose of this paper is to help contribute to the deeper understanding of this problem.

II. Literature Review

A lack of transportation can cause social exclusion to marginalized groups of people. A study done by Vecchio focused on social exclusion caused by transportation and the effect the TransMilenio, a large bus rapid system in the city of Bogota, had on urban access. In the case study, Vecchio found that areas of Bogota where residents don't have access to basic needs face more difficulty in everyday mobility which was emphasized by the geographical location of these parts of the city. He stated that personal, social, and spatial features are factors that lead to an individual's capacity for everyday mobility (Vecchio, 2017). These factors are important to create a population regression line to describe the issue of a lack of stable transportation.

Another important factor to a person's ability to have a stable source of transportation is their level of income. Blumenberg and Agrawal examined the transportation coping strategies of low-income individuals in San Jose, California. These people stated that they greatly reduced the amount of overall traveling and altered trips due to higher cost of certain transportation uses (Blumenburg & Agrawal, 2014). Since the people included in this study are forced to constantly change their transportation use, they lack a stable source of transportation. In a case study done in the Paris region of France, inequalities in income were also shown to explain 44 percent, 29 percent, and 38 percent of inequalities of travel distribution for the years 1983, 1991, and 1997 respectively (Purwanto, 2016). Likewise, in a study on the issue of suburbanization and its effects on poverty, Riddick (2014) included median income in a panel regression which was used to determine that there was a significant positive relationship between the expansion of highways and poverty concentration. Since access to each individual's income was not given in the data provided by the Louisville Urban League, each individual will be linked to the median income given of the zip code they reside in for this study, similar to the study done by Riddick.

A person's access to transportation is also related to a person's employment status (Lichtenwalter, Koeske, & Sales, 2008). In their study of low-income working women in the Pittsburgh area, they used regression analysis to measure the mobile disparities between those who owned private vehicles and those that used other modes of transportation. They found that women who had access to private vehicles had more satisfactory employment outcomes. It was

shown in the study that the difference between having private vehicles compared to other modes of transportation had an even greater impact on the individual's employment outcome than previous education or work experience. Given this relationship between the availability of transportation and the individual's employment status, a person's employment status should be incorporated into the population regression line of this study.

Many of the individuals that completed the Louisville Urban League survey live in areas of Louisville that have high crime rates. There are many cases when people are victims of crime on public transportation which causes fear in people and more hesitancy in using public transportation. In a study done on the fear of crime in public transport in Mexico City, it was found that approximately 36 percent of public transport users felt unsafe (Vilalta, 2011). Also, it was found that fear of crime was higher in young users. Fear of using public transportation can lead to a person being less likely to use it and not having a stable source of transportation. In order to reflect this information in the study, a variable that links each individual to the crime rate of the zip code of their residency will be added to the population regression line.

People's living arrangement also play a role in their transportation needs and the affordability of transportation. Hass, Newmark, & Morrison study the interaction between housing costs and transportation. They show that automobile ownership is positively related to monthly housing costs and the relationship was 54 percent stronger for those that owned property rather than rented (Hass, Newmark, & Morrison, 2016). The importance of the relationship between people's living arrangements and transportation will be identified in the population regression line of this study with variables identifying if a person owns or rents a property.

Other individual characteristics can also be used to determine a person's usage of transportation. Kurosaki (2012) used individual characteristics such as distance to nearest metro from a person's residence, house tax classification, age, education, religion, and caste background as variables in a regression model to study the effects of the Delhi Metro on the Cycle Rickshaw market. The Louisville Urban League provided information about clients such as age, race, and zip code of residency which can be used in the population regression line of a regression model for this study. Similarly, to Kurosaki's use of the distance from the nearest metro station, Shapley (2015) used accessibility to airports and proximity to interstate highways in a study on poverty and transportation infrastructure in the southern region of the United States. Shapely also used the accessibility to airports as a variable in his study. He found that there was significant correlation between health outcomes of individuals and accessibility to an airport. To represent distance and location in this study, the zip codes of clients provided in the data by the Louisville Urban League will be integrated into the model by linking each individual to data about the zip code of their residence.

Examining the transportation infrastructure of a city is critical when trying to determine causes of a lack of stable transportation. An important part of a city's infrastructure is the public transportation system. Public transportation is important for those who don't have access to a personal vehicle. The accessibility of the public transport system can determine whether a person has stable transportation (Murray, Davis, Stimson, &Ferreira, 1998). The major public transportation system of Louisville is the Transit Authority of River City commonly known as TARC. In the survey done by the Louisville Urban League, one question asks individuals if they use the TARC. Since usage of public transportation is important to an individual's access to

stable transportation, this information should be implemented into the model through a dummy variable that will indicate if an individual uses the TARC.

It is also important to include variables for other sources of transportation than public transportation in the model. There are many people who drive themselves, so it will be included as a variable in the model. Other people must depend on others such as family members and friends to drive them. In a study of low-mobility individuals in a small Utah community, it was found that those with better social and family ties were much more likely to have their transportation needs met (Jansuwan, Sarawut, Christensen, & Chen, 2013). One of the questions asked on the survey provided by the Louisville Urban League was if an individual relied on family for transportation. This information will be used as a dummy variable in the model.

III. Data and Model Specification

These studies have an emphasis on the relationship between transportation and marginalized individuals. Using the information gathered from these studies and the data given by the Louisville Urban League, the focus of this study is on what different personal factors lead to a lack of adequate transportation for an individual. An initial population regression line was formed for this model using the data provided below. The expected sign and reasoning for each variable is also listed below. The expected sign indicates the relationship the variable should have in relationship to the dependent variable of the number of times transportation is cited as a need. These expected signs are based off theory and deductive reasoning.

$$TN = \beta_0 + \beta_1 CRIMER + \beta_2 MINCOME + \beta_3 OWN + \beta_4 RENT + \beta_5 TARC + \beta_6 FAM + \beta_7 DRIVE + \beta_8 RACE + \beta_9 EMP + \varepsilon.$$

The number of times a person cited transportation or a related issue as a top three need is the dependent variable abbreviated as TN. Then β_0 is the intercept. The first two independent variables are crime percentage by zip code (CRIMER) and median income by zip code (MINCOME) which are associated to each individual's zip code they identified on the survey. The other independent variables are categorical data that can be represented by either the absence or presence of a certain condition and are therefore treated as dummy variables and are listed below:

- (OWN) where 1 indicates owning property and 0 if not
- (RENT) where 1 indicates that an individual rents and 0 if not
- (TARC) where 1 indicates that an individual uses the TARC and 0 if not
- (DRIVE) where 1 indicates an individual drives themself and 0 if not
- (FAM) where 1 indicates that an individual relies on family for transportation and 0 if not
- (RACE) where 1 indicates they are African American and 0 if not
- (EMP) where 1 indicates that the individual is employed and 0 if not

Table 1: Signs and Expected Values of Variables

Variable	Symbol	Expected Sign	Reasoning for expected sign
Number of times transportation is cited as a need	TN	Y	- -
Crime percentage by zip code	CRIMER	Positive	A high crime rate leads to less use of public transportation which increases the likelyhood for lack of stable transportation.
Median income by zip code	MINCOME	Ambiguous	All individuals in the survey are relatively low income and thus some may list more important needs even though they may have a lack of transportation.
Dummy variable for owning property	OWN	Ambiguous	A person who owns a house is more likely to afford personal transportation but less likey to live near public transportation.
Dummy variable for renting	RENT	Ambiguous	A person who rents is less likely to own personal transportation but may live closer to public transportation.
Dummy variable for TARC as primary transportation	TARC	Ambiguous	The ability to use TARC as a stable source of transportation varies on a individual's distance from TARC stops and intended destinations.
Dummy variable for family transportation	FAM	Negative	A person who can rely on family for transportation will not cite a lack of transportation as a need.
Dummy variable for using personal vehicle	DRIVE	Negative	A person who owns a personal vehicle will have stable transportation.
Dummy variable for race	RACE	Ambiguous	It is difficult to determine a individual's need for stable transportation solely based on race.
Dummy variable for employment status	EMP	Positive	Employment leads to greater need for transportation.

These variables were chosen for the initial population regression line because they are the variables that can be used from the data that intuitively could influence the number of times someone cited transportation as a need. The independent variables and the expected signs from theory are listed in Table 1 above.

IV. Econometric Analysis

A. Initial Regression Model

The initial regression results are shown below. The variables RENT and EMP are significant at 10 percent, and MINCOME is significant at 5 percent. The variables CRIMER, OWN, TARC, and FAM have p-values of 0.135, 0.108, 0.122, and 0.126 respectively which are still relatively significant. The variables DRIVE and RACE, however, had high p-values of 0.67 and 0.62 respectively indicating that they are not as important in explaining why an individual may have a lack of stable transportation. Since there is not strong theoretical evidence to suggest that RACE should stay in the model, a formal omitted variable test was performed. The expected and actual bias of the other variables were compared as well as the adjusted r squared value, and it was deemed that RACE should be removed from the specification. After removing RACE from the model, the adjusted R Squared increased to 0.456, and the variables are jointly significant at 1%.

Table 2: Regression Statistics

Multiple R	0.782
R Square	0.611
Adjusted R Square	0.436
Standard Error	0.350
Observations	30

Table 3: Variable Coefficients and Significance

Y=TN	Coefficients
Intercept	-1.440
Crime Percentage (CRIMER)	0.188
Property Ownership (OWN)	0.729
Rent Status (RENT)	-0.361*
TARC Primary Transportation (TARC)	0.444
Family Primary Transportation (FAM)	-0.355
Personal Vehicle Primary Transportation (DRIVE)	-0.092
Individual's Race (RACE)	0.099
Employment Status (EMP)	0.347*
Median Income (MINCOME)	2.44E-05**

*p<0.10, **p<0.05, ***p<0.01

A formal omitted variable test was also performed on DRIVE. Even though adjusted r squared increased slightly when DRIVE was removed from the specification, the actual and expected biases when DRIVE was compared to other variables did match which indicates it is important to the model. Therefore, it was decided that DRIVE would remain in the model. This decision is

also supported theoretically since an individual's ability to drive themself should help determine if they have stable transportation.

B. Multicollinearity

A correlation matrix was generated to determine if there is multicollinearity. As shown in table 4, there are signs of multicollinearity between MINCOME and CRIMER since the absolute value of the correlation matrix value for MINCOME and CRIMER is greater than 0.7. Thus, it will be important to be aware of these variables when checking the variance inflation factors.

Table 4: Correlation Matrix

	CRIMER	OWN	RENT	TARC	FAM	DRIVE	EMP	MINCOME
Crime Percentage (CRIMER)	1							
Property Ownership (OWN)	-0.165	1						
Rent Status (RENT)	-0.077	-0.122	1					
TARC Primary Transportation (TARC)	-0.147	-0.083	0.488	1				
Family Primary Transportation (FAM)	0.120	0.263	-0.309	-0.316	1			
Personal Vehicle Primary Transportation (DRIVE)	-0.154	-0.141	-0.045	-0.340	-0.538	1		
Employment Status (EMP)	0.112	-0.102	0.327	-0.035	-0.223	0.071	1	
Median Income (MINCOME)	-0.879*	0.279	0.099	0.093	-0.047	0.058	0.019	1

* Absolute value of correlation matrix value is greater than 0.7

Next, the variance inflation factors (VIFs) were generated for each variable. As shown in table five below, CRIMER and MINCOME have variance inflation factors of 5.4854 and 5.4171 which indicates very mild multicollinearity. However, when removing the variables from the model, there were no significant improvements to the model. Adjusted r squared remained relatively similar to the previous value and the fluctuations in significance of other variables did not benefit the model overall. Since there are no improvements to the model by removing CRIMER or MINCOME, they are theoretically important variables, and there is only very mild multicollinearity, CRIMER and MINCOME will remain in the model.

Table 5: VIF Values

Variable	R Square	VIF
Crime Percentage (CRIMER)	0.818	5.485*
Property Ownership (OWN)	0.181	1.221
Rent Status (RENT)	0.372	1.593
TARC Primary Transportation (TARC)	0.606	2.537
Family Primary Transportation (FAM)	0.62	2.626
Personal Vehicle Primary Transportation (DRIVE)	0.624	2.659
Employment Status (EMP)	0.271	1.371
Median Income (MINCOME)	0.815	5.417*

*VIF>5

C. Heteroscedasticity

To ensure that the model is robust and a best linear unbiased fit (BLUE), it must be checked if heteroscedasticity is present. The Park Test and a modified White Test will be performed. The Park Test is used to determine if there is pure heteroscedasticity with non-constant variance that exists in the model. In order to perform the Park Test, the following regression equation is used:

$$\ln(e^2_i) = \alpha + \beta_1 \ln(z_i) + v_i.$$

Then z will be checked for significance. The Park Test was only preformed on CRIMER and MINCOME because the other variables are dummy variables that include 0 which the natural log of is undefined. When the Park Test was performed on MINCOME, there was a P-value of 0.2459 which means it is insignificant even at 20%. Similarly, when the Park Test was performed on CRIMER, there was a P-value of 0.6776 which means CRIMER is insignificant even at 20%. Therefore, there is no indication of heteroscedasticity caused by MINCOME or CRIMER.

The modified White Test helps to ensure there is no heteroscedasticity in the model but rather the error term and variables are homoscedastic. The sub-regression that is used for the modified White Test is:

$$e_i^2 = \beta_0 + \beta_1 Y\hat{} + \beta_2 (Y\hat{})^2 + \varepsilon_{i..}$$

The r-squared value for the sub regression is 0.2981 and with 30 observation points. Next, a chi-square statistic value is generated by taking the r squared value and multiplying it by the number of observation points. It is then compared to the chi-square critical value. The chi-square statistic value was calculated to be 8.943. Since this is smaller than the chi-square critical value of 9.21 for two degrees of freedom at 1%, it indicates that the variables are homoscedastic and there is no heteroscedasticity in the model. Since there are no signs of heteroscedasticity in the model, the PRL remains the same.

V. Results

The final PRL and the results in table six are displayed below. MINCOME is shown to be the most significant variable from running the regression. It is significant at 5 percent with a P-value of 0.018 and is positively related to the number of times someone cited a lack of stable transportation. According to the regression, RENT is the second most significant variable and is significant 5 percent as well. It is negatively related to the number of times an individual cited having a lack of transportation. EMP and FAM are both significant at 10 percent. EMP has a positive relationship with TN while FAM has a negative relationship with TN. TARC, OWN, and CRIMER are all marginally significant with P-values less than 15 percent and positively related to TN. Lastly, DRIVE was shown to be insignificant but has the expected negative sign for its coefficient.

Very slight multicollinearity was identified in the model, however, there did not appear to be any major issues with the model. Thus, the sample slopes appear best, linear, and unbiased since there were no signs of perfect multicollinearity or heteroscedasticity. Therefore, the model can be used to learn about the relationship between personal factors and a lack of stable transportation.

$$TN = \beta_0 + \beta_1 CRIMER + \beta_2 MINCOME + \beta_3 OWN + \beta_4 RENT + \beta_5 TARC + \beta_6 FAM + \beta_7 DRIVE + \beta_8 EMP + \varepsilon_i$$

Table 6: Variable Coefficients and Significance

Y=TN	Coefficients
Intercept	-1.417
Crime Percentage (CRIMER)	0.196
Property Ownership (OWN)	0.64
Rents Status (RENT)	-0.361**
TARC Primary Transportation (TARC)	0.429
Family Primary Transportation (FAM)	-0.372*
Personal Vehicle Primary Transportation (DRIVE)	-0.097
Employement Status (EMP)	0.357*
Median Income (MINCOME)	2.54E-05**
*p<0.10, **p<0.05, ***p<0.01	Adjusted R Square = 0.456

VI. Implications

The purpose of this research was to determine which individual factors were important in identifying a person's need for more stable transportation. The dependent variable of the model was the number of times an individual cited transportation or a related issue as a top 3 need and was abbreviated as TN. The independent variables were the crime percentage by zip code (CRIMER), median income by zip code (MINCOME), a dummy variable for owning a property (OWN), a dummy variable for using the TARC (TARC), a dummy variable for whether an

individual drives themselves (DRIVE), a dummy variable for relying on family for transportation (FAM), and a dummy variable for if the individual is employed (EMP). These variables were chosen for the model since they are variables that intuitively can have the greatest impact on a person's transportation needs. The most interesting finding of this research is that the dummy variable for whether a person drives a car (DRIVE) is not important in determining if a person needs help in securing stable transportation. The results indicate that rather the median income is much more important in determining whether an individual cites needing help in securing stable transportation.

A possible explanation for why whether a person drives themself or not (DRIVE) is insignificant is because many of the individuals who took the survey are ranged between 16 and 25. Many of them are still dependents who may be living with parents and guardians who are also needing to use the vehicle. However, many of them can rely on driving themselves if others in the family do not use the same vehicle. Thus, leading the variable DRIVE to be less significant in determining a person's need for stable transportation. This may also be why whether a person relies on family for transportation or not (FAM) is much more significant. A young individual is very likely to depend on others in their family to help with transportation which makes it a much more significant variable in determining whether the individual will have a stable source of transportation.

Another important takeaway from this study is that the most significant variable is the median income of the zip code that a person resides in (MINCOME). The regression shows that MINCOME is positively related to the number of times an individual cited a lack of transportation. Since all the individuals in this survey have relatively low income and the individuals with the lowest incomes listed other more important needs such as finding a job, paying rent or mortgage, or housing security as top three needs instead of finding stable transportation it leads to MINCOME being positively related to the number of times a person cited transportation as a top three need (TN).

It is important for organizations such as the Louisville Urban League to help their clients who have to commute have a stable source of transportation. There are many ways to achieve this goal. Non-profit organizations can assist individuals in finding housing closer to public transportation or their work, help them find better employment opportunities, and use donations to buy personal transportation for these individuals.

The most challenging aspect of this study was having limited access to information about the individuals that answered the survey. Since the income and the value of the house or cost of rent for each individual was unknown, the related variables had to be generalized. These variables should be more personalized in further research of the topic given appropriate data. However, the model generated in this study is robust and has emphasized the importance of factors such as income, employment, and housing in a person's ability to have a stable source of transportation.

VII. References

Blumenberg, Evelyn, and Asha Weinstein Agrawal. "Getting around When You're Just Getting by: Transportation Survival Strategies of the Poor." *Journal of Poverty* 18, no. 4 (2014): 355–78.

Haas, P. M., G. L. Newmark, and T. R. Morrison. “Untangling Housing Cost and Transportation Interactions: The Location Affordability Index Model—Version 2 (LAIM2).” *Housing Policy Debate* 26, no. 4-5 (2016): 568–82.

Hobson, Jeff. "Overcoming roadblocks to transportation justice." *race, poverty & the environment* 12, no. 1 (2005): 29-31.

Jansuwan, Sarawut, Keith M. Christensen, and Anthony Chen. “Assessing the Transportation Needs of Low-Mobility Individuals: Case Study of a Small Urban Community in Utah.” *Journal of Urban Planning and Development* 139, no. 2 (2013): 104–14.

Kurosaki, Takashi. "Urban transportation infrastructure and poverty reduction: Delhi metro’s impact on the cycle rickshaw rental market." *Institute of Economic Research, Hitotsubashi University* 24 (2012).

Lichtenwalter, Sara, Gary Koeske, and Esther Sales. “Examining Transportation and Employment Outcomes: Evidence for Moving beyond the Bus Pass.” *Journal of Poverty* 10, no. 1 (2006): 93–115.

Murray, Alan T., Rex Davis, Robert J. Stimson, and Luis Ferreira. “Public Transportation Access.” *Transportation Research Part D: Transport and Environment* 3, no. 5 (1998): 319–28.

Purwanto, Joko. “Does a Rise in Income Inequality Lead to Rises in Transportation Inequality and Mobility Practice Inequality?” *Social Inclusion* 4, no. 3 (2016): 110–32.

Riddick, Winston. "The impact of suburbanization on poverty concentration: using transportation networks to predict the spatial distribution of poverty." (2014).

Shapley, Derrick. *Isolation in the South: Poverty and transportation infrastructure in the Black Belt*. Mississippi State University, 2015.

Vecchio, Giovanni. "Democracy on the move? Bogotá’s urban transport strategies and the access to the city." *City, Territory and Architecture* 4, no. 1 (2017): 1-15.

Vilalta, Carlos J. “Fear of Crime in Public Transport: Research in Mexico City.” *Crime Prevention and Community Safety*13, no. 3 (2011): 171–86.

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