

# ASSESSMENT OF TRANSPORTATION PREFERENCES BY MEANS OF LABORATORY EXPERIMENTS

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## Abstract

The article looks at how people react to changes in various factors affecting the use of private vs. public transport. The authors describe transportation issues confronting the population of urban areas. An overview is done of scholarly work on the problem of preference assessment by means of sociological surveys and laboratory experiments. The authors analyze the methodological framework of laboratory experiments and improve the method of public good experiments. The proposed research method is a laboratory experiment based around a survey asking students whether they prefer public or private transport. The experiment envisages that the cost of the trips by public transport and by car varies. Following the experiment, the students' readiness to use public transport is assessed for different cost ratios. The second variable parameter of the experiment was travel time. The authors assess the readiness of students to use public transport under various ratios of travel time by private and public transport. A conclusion is made that transportation preferences vary significantly depending on the factors of price and time. The aim of the research is to develop a method of assessing transport preferences of people living in urban areas with regard to private vs. public transport.

**Key words:** transportation preferences, laboratory experiments, public transport, private transport

**JEL Code:** H23, R40

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## Introduction

Population mobility and labor mobility in the first place is an important factor of economic development in any country. Such mobility should be manifested in a number of aspects. At the national level, mobility should ensure worker migration from regions with low demand for workforce to regions with high demand for workforce. At the regional level, mobility should ensure the migration of workers to municipalities where there is a shortage of workforce. At the municipal level, mobility ensures daily pendulum migration of workers from home to work.

All types of migration are always accompanied with the choice of the means of transport. Private vehicles and public transport are the two options that people choose from when implementing mobility. These two alternatives are relevant to all types of migration, but the modes of public transport vary. Country-wise, privately owned cars can compete with air transport, railways and water transport. Private transport can compete with railways and coaches when mobility is implemented at the regional level.

The strongest competition between privately owned cars and public transport occurs in the course of daily pendulum migration from home to work (school) and back. Most commonly, such migration is done by means of car travel. As a result, pendulum migration results in the biggest number of negative effects stemming from the use of private vehicles in an urban agglomeration. These include traffic congestion during rush hours, air pollution, parking shortages, the use of recreation areas (lawns, courtyards, parks) and downtown road spaces for parking during daytime hours.

The negative effects can only be mitigated through a shift in transport choices of individuals involved in pendulum migration. Public transport should become the predominant choice for them because it ensure the least number of negative effects (Magaril, 2013). Public transport is more effective for the purposes of pendulum migration because it makes it possible to minimize the burden on the road network of cities and relieves shortages of parking space. Business districts of cities become more comfortable for work, studying and communicating.

In practice, though, it is rather difficult to change people's transport habits. It is necessary to study the reasons that might encourage car owners to decide against driving to work (Leontyeva, 2016). It is necessary to investigate the variables that will prompt a shift in transport choices in favor of public transport.

The aim of the research is to develop a method of assessing transport preferences of people living in urban areas with regard to private vs. public transport.

## **1 Review of literature**

The theoretical study into transport choices will be conducted by means of laboratory experiments. Over the past few decades behavioural economics has received a strong impetus. Initially economists used laboratory experiments for verifying econometric models and theoretical forecasts. Over the past few decades laboratory experiments have allowed a wider application of research findings. One of the most important trends in laboratory experiments today is the harvesting of information about economic agents' behavior.

Vernon Smith earned the 2002 Nobel Memorial Prize in Economic Sciences for "for having established laboratory experiments as a tool in empirical economic analysis, especially in the study of alternative market mechanisms". Smith believes that economic experiments help close the gap between decision theory and decision behavior, and the gap between evidence concerning how people think about economic questions and evidence concerning how people behave in experimental markets (Smith, 1991).

Economic experiments have proved methodologically valid. Unlike standard theoretical work, laboratory experiments do not require simplification and, as a result, they make it possible to take account of multiple factors. Most importantly, unlike traditional empirical studies, laboratory experiments generate the necessary data. This is particularly important for problems when such data cannot be mined outside the laboratory. For example, this is a case when the data is not available in official statistical reports or conventional marketing surveys (Kagel, 1995).

An essential part of experiment design is offering rewards to participants. This makes it possible to control the experiment as a process. Smith believes that the reward should be (a) confidential, that is, other participants should not be aware of its size; (2) substantial enough for the participant receiving it, that is, it should serve as an incentive; (3) it should be related to the results of the participants' actions (Smith, 1976).

Traditionally, the issue of income in tax evasion experiments poses a methodological problem. During the pioneer experiments, all participants received equal income (Freidland, 1978). L. Bosco criticized such method of income allocation. The criticism boils down to the fact that providing students with an abstract sum calculated in a virtual currency does not encourage the participants to perceive the experiment as a real process (Bosco, 1997). The approach creates the notion of the experiment being a game and drives the students to take in-game decisions about paying or evading taxes that can significantly distort the results of the experiments. To make an experiment look more like a real-life situation, the L. Bosco and L. Mittone suggested giving students cash as their actually earned income (Bosco, 1997).

J. Alm studied so-called public-goods experiments. The method is different in presenting participants with two choices. They are to decide whether to invest their money in private goods or public goods (Alm, 2011). When investing in public goods, the participant sees their invested capital grow, but it is then shared evenly among all experiment participants. If all participants have invested their money in public goods, that will yield the maximum benefit for all.

Research on tax compliance is a very popular application of laboratory experiments. The methods of standard tax evasion experiments was developed in the 1980s (Freidland, 1978, Spicer, 1980). The possibility of using laboratory experiments for research on transport choices is a yet little explored field that has not received proper attention of the economic community.

Our experiments in transport choices might be built around the method of public-goods experiments because participants, when choosing their own car or public transport, decide whether to invest their money in the development of private or public goods.

## **2 Materials and Methods**

The proposed research method is a laboratory experiment formatted as a survey of students to learn about their transport behavior when faced with the choice between private vehicles and public transport for daily pendulum migration.

Four groups of 25 students each were selected for the survey. The students were studying for undergraduate degrees in economics. To ensure comparability of results, all subjects were picked among third-year students, their average age being 20 years.

The experiment consisted of two stages. At stage one, the students earned an income measured in points by giving correct answers to questions in a test. At stage two, the students learnt about the size of their income and were to choose how they would make a set number of trips to school – either by car, or by public transport.

The students were given questionnaires consisting of two parts. Part one contained economic-themed questions that made it possible to evaluate the students' professional competency and their moral convictions about voluntary compliance. The students earned their income by answering the questions from part one of the questionnaire. All groups of subjects had identical questionnaires regardless of their majors and time of the survey.

The questionnaires were supplemented with questions that revealed the students' disposition the family income (whether the family has an apartment, a country house, a car). The personal questions were included in part two of the questionnaire. The answers to the questions did not contribute to the students' 'income', but were used only for creating their personality profiles.

We decided to create the real-life environment of the laboratory evasion experiment by motivating students with grades. The reason is that our university follows a grading system that evaluates knowledge on a 100-point scale. If a student earns 80% of maximum grade points, which is only possible if he or she gets top grades for all assignments, he or she is entitled to a

first class pass in the course. The possibility of earning points during a course and thus avoiding the final test provides very good motivation for students. Consequently, awarding points to students as their income in the experiment encourages them to participate in the experiment and drives them to do things in order to earn the income. The approach is a methodological innovation that we added to the laboratory evasion experiment design.

Eventually, the rationality of the students' transport choices was driven by their desire to save a fairly large part of their income to get a higher grade in the course. This motivation forces the students to be frugal with the income, treating it as real money, which brings the choices exhibited by the students during the experiment closer to their real life behavior.

The experiment contained basic assumptions, variables and constants. The key assumption was that all subjects own a car. The second assumption was the availability of a public transport stop within walking distance.

The constant was the number of trips from home to school and back that the students were to make regardless of their income. The variables were different transit fares and the duration of trips. Three different ratios of the prices of car rides and trips by public transport were tested. There were also three different ratios of travel time expenditures when using private and public transport.

### 3 Analysis of results

A series of experiments yielded meaningful results. We shall structure the results around the training methods and demographic profiles of the students.

#### 3.1 Analysis of transport choices at different price levels

Table 1 shows the results of laboratory experiments with different ratios of prices of car rides and trips by public transport. The results are differentiated by demographic traits of the subjects, namely their gender and the income level of the families they grew up in.

**Tab. 1: Choice of public transport depending on the prices of travelling by car and public transport, %**

№	Index	Share, %	Ratio of prices of trips by public transport and by car (in equivalent units)		
			1.0 : 1.0	1.0 : 1.5	1.0 : 2.0
1	Sample:				
	men	25	3	35	68
	women	75	1	18	39

2	Income level				
	higher than the median	65	0	27	51
	lower than the median	35	7	43	88

Source: compiled by the authors

The experiment found that when the prices of travelling by car and by public transport are the same, practically all participants opt for private cars. Things turn around only when there is disparity, with the price of a car ride being 50 percent higher than a single bus fare. In this case, 18 percent of women and 35 percent of men choose to use public transport to go to work (school). When the price of a car journey is twice as high as that of a bus ticket, as many as 39 percent of women and 68 percent of men opt for public transport. However, one cannot be sure that there is a price ratio that will make costumers decide against using cars altogether.

Consumers' demographic traits make a big difference to their transport choices. For example, one could notice a strong gender division in transport behavior. It is possible to conclude that men take a more pragmatic approach to choosing a means of transport. Quantitatively, there is almost a two-fold difference in the travel behavior responses of men and women. For women, transport comfort will be more significant a factor than the price of the trip, while men will give priority to the price issue when choosing the means of transport.

There is an interesting correlation between behavior responses and the income level. It has to be noted that the income that the student earns during the experiment is significantly different from the income of the family he or she was raised in. The reason is that the earned income determines their current ability to pay, while the wealth of their family indicates their long-term solvency. Consequently, these parameters form different behavioral responses.

Consumers from well-off families are less inclined to choose public transport even where there is a significant price difference between the modes of transport. For example, if traveling by car costs 50 percent more than by public transport, only 27 percent of persons from well-off families are prepared to opt for public transport, whereas the share of students from low-income families choosing public transport is much higher – 43 percent. When the price of a car ride is twice as high as that of a public transport fare, 51 percent of persons from well-off families are prepared to take a bus to go to school, while the share of students from low-income families opting for public transport is drastically different – 88 percent.

Therefore, the conducted laboratory experiments with different ratios of prices of car rides and trips by public transport infer a conclusion that the price ratio is an important factor impacting consumers' decision when choosing a means of transport. Consequently, in order to achieve a shift in behavioral responses of people toward public transport it is necessary to

increase the price disparity between privately owned cars and public transport for making otherwise identical trips.

### 3.2 Analysis of transport choices for various duration of travel

Table 2 shows the results of laboratory experiments for the variable parameter "duration-of-trip ratio between private vehicles and public transport". The results are also differentiated by demographic profiles of participants such as their gender and the income level of their families.

**Tab. 2: Choice of public transport depending on travel time by car and public transport, %**

№		Share, %	Ratio of the duration of trip by car and by public transport (in equivalent time units)		
			1.0 : 1.0	1.0 : 1.5	1.0 : 2.0
1	Sample				
	men	25	3	41	92
	women	75	0	20	52
2	Income level				
	higher than the median	65	0	31	67
	lower than the median	35	3	30	68

Source: compiled by the authors

The experiment found that when the duration of trips made by car and by public transport is the same, practically all participants opt for private cars. The situation begins to change when there is a disparity between the time spent on similar trips by car and by public transport. For example, when a trip by car takes 50 percent more time than a bus ride, 20 percent of women and 41 percent of men choose to travel to work (school) by public transport. When traveling by car takes twice as long as traveling by public transport, as many as 52 percent of women and 92 percent of men will opt for public transport. However, one cannot be absolutely certain that consumers decide against using cars at any duration-of-trip ratio.

The analysis also revealed correlations between behavioral responses of transport users and their demographic traits, gender having the strongest impact. As is the case with the price of a trip, men perceive the time factor more pragmatically when forming a preference for a mode of transport. Quantitatively, there is a two-fold difference in the responses of men and women. For women, transport comfort will be more significant a factor than travel time, while men will give priority to the travel time factor when choosing a mode of transport.

It should be noted that unlike the price factor that had a strong influence on the transport choices of consumers with different levels of income, the travel time factor has equal weight

for all consumers. For example, if a car trip takes 50 percent more time than travelling to the same place by public transport, 31 percent of students from well-off families and 30 percent of students from low-income families are prepared to opt for public transport. If travelling by car takes twice as much time as the public transport option, 67 percent of students from well-off families and 68 percent of students from low-income families are prepared to travel to school by public transport. We can see that there is practically no difference in time-based responses of consumers with different levels of income.

The conducted laboratory experiments with different travel times set for car rides and trips by public transport allows for a conclusion that the travel time ratio plays an even more significant role in the consumer's decision to travel by a specific mode of transport. Consequently, in order to achieve a transport modal shift toward public transport it is necessary to increase the disparity between the duration of a car journey and public transport travel time in case of identical destinations.

## **Conclusion**

Conducting economic experiments among students generates a substantial dataset about people's transport choices. The authors have improved the method of the public-goods experiment. A peculiarity of the authors' method is the use of grade points as the currency paid to students for correct answers to questions in the course-related part of the quiz. The students' final course grade depends on the amount of points earned by them. The approach ensures that students view the points as real money, thus bringing their preferences exhibited during the experiment closer to real-life choices.

A study of people's travel behavior under the influence of two variables yielded the following outcomes. The ratio of prices of car rides and trips by public transport is an important factor by changing which it is possible to shape people's transport choices. In order to achieve a shift in travel behavior of people toward public transport it is necessary to lower public transport fares and increase the cost of travelling by car.

The travel time ratio between car journeys and public transport trips plays an even more significant role in changing people's travel behavior. In order to achieve a transport modal shift toward public transport it is necessary reduce public transport travel time and increase the duration of car trips.

The laboratory experiment has revealed strong gender differences in travel behavior. It is possible to conclude that men take a more pragmatic approach when forming their transport choice. There is a significant difference in travel behavior responses on men and women.

### **Acknowledgments**

The work was supported by the Russian Foundation for Basic Research, contract No. 17-22-21001.

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