

ECONOMIC MOTIVATION AND OTHER DRIVERS OF CONSUMERS FOR PUBLIC TRANSPORTATION - METRO FORWARD CIRCULAR ECONOMY IN HA NOI

PhD. Nguyen Thi Thuy Dung*

Abstract: *The article studies the economic efficiency of switching the transportation of a group of individuals (96 people) in Hanoi in March 2024 from existing means to public transport, Metro. The research calculates the economic efficiency of that transfer activity for individuals based on three factors: age, income, and distance travelled, and it finds out whether the factors influence these groups by One-way ANOVA Test. In addition, the study also found seven groups of factors that can significantly influence consumers' switching decisions and conducted an AHP Analytic Hierarchy Process (AHP) analysis to determine the main factors promoting their switching. The study results found several statistically significant differences, showing that distance will significantly impact economic efficiency. The study also supported the idea that economic benefits are not the leading factor in the switching decisions. From there, the study also made several related comments and recommendations.*

• Keywords: *circular economy, economic motivation, metro, public transportation.*

Date of receipt: 03rd Nov., 2024

Date of receipt revision: 12th Dec., 2024

Date of delivery revision: 10th Nov., 2024

Date of approval: 05th Feb., 2025

DOI: <https://doi.org/10.71374/jfar.v25.i1.08>

1. Introduction

Circular Economy is a broad concept that addresses the problem of lack of input resources for modern society's activities and the problem of environmental harm caused by increasing waste sources. The most commonly mentioned solutions are reducing the consumption of precious resources and extending the life cycle of resources through recycling and reuse.

In the field of transportation, the circular economy demonstrates the perspective of saving resources in shifting to resource-saving means of transport, such as vehicles running on clean energy instead of traditional vehicles, designed Vehicles that are more resource-efficient than traditional vehicles, public vehicles.

Within the scope of the research article, the author will focus on the shift to public transportation, specifically Metro (Metro), a transportation activity that has been popular in developed countries over the years and has become the primary means of public transport in many countries. The pilot in the capital, Hanoi, with the Cat Linh - Ha Dong Metro railway, is one of the first projects towards that goal.

The study will evaluate the economic efficiency of the transfer for individuals transferring to Metro using the formula for calculating the difference in cost savings of the transfer. It will also analyze differences in age, income, and travel distance of research subjects and test One Way Anova to see the impact on economic efficiency based on three primary factors.

The research will also analyze seven psychological factors considered the main drivers for migration and determine which factors will influence migration the most through AHP testing.

Research hypotheses are built as follows:

H1: Age has an impact on cost savings

H2: Income has an impact on cost savings

H3: Distance has an impact on cost savings

H4: Economic motives are more influential than other motives in decision-making

The structure of the research article is as follows: Part 2 is the research overview, part 3 is the data and research methods, part 4 is the research results, and part 5 is the research recommendations and some limitations.

* University of Transport and Communications; email: dungnt89@utc.edu.vn

2. Literature review

Each industry in the economy has its problems and characteristics that can develop towards a circular economy in different ways. Many researchers have sought to concretize the concept of CE to monitor, evaluate, and record different perspectives on CE in different industries, typically the 10 R scale given by Potting et al.. This scale is widely used as a criterion to concretize the concept of CE in different fields. For physical production, 3R and 4R are most widely applied and aim to extend the life cycle of materials through reducing, reusing and recycling.

However, in the service sector, the service itself does not have a physical form to carry out recycling, so the service sector towards CE will focus on other R aspects and especially R1: rethink.

Public transport can be buses, trains, submarines, sky trains, and trams, and with the technology in the world today, for urban areas, Metro trains, especially are considered a means of improving exploitation efficiency from the perspective of saving raw materials and protecting the environment the most

Many studies focus on the economic benefits of public transport users compared to before and find a proportional relationship, meaning that the more people use public transport, the more they save money.

However, the level of economic benefits that people save will depend on many factors. Studies suggest that young people have a good attitude toward public transportation. When young people move a lot, switching to public transport will reduce the total cost of travel to a great extent. From there, the benefits for young people outweigh those for middle-aged or older adults.

The income of people in urban areas may affect the level of savings benefits because people with different income levels will often choose work locations with different living environments. Low-income people in urban areas often stay far away from the working environment, so switching vehicles to public transport will save much money. High-income people often have high incomes enough to live near their workplaces, so the cost savings will not be as significant

Travel distance is considered a major influence on the transition to Metro. However, a long average commute can also be the route of people who have the purpose of moving continuously, meaning that the actual portion of this group's transfer to Metro is low compared to their actual travel distance and makes their cost savings not high.

Besides research on the sustainable motivation of the transition, in order for the transition to public transport to be highly sustainable, many people believe that the economic motivation of participants must be guaranteed. However, many people believe that other factors, such as avoiding traffic jams, providing comfort, and diminishing the problem of psychological inhibition caused by traffic jams in large cities, are more influential factors.

Some studies focus on environmental motivation, not personal issues, which are one's economy or personal comfort, dedication, social responsibility, and the environment as the factors in deciding to switch. Some studies mention another personal motivation: the motivation to affirm self-image through public transportation to demonstrate environmental responsibility, a derivative motive formed from a legitimate environmental motive. Besides, the psychology of following the crowd without a clear personal motive.

Another motivation discovered by some research is the benefit of travelling between the train station and the final destination, it gives an opportunity to do walking, which is good for health. Besides, for some people, public transportation makes them feel safer and reduces the possibility of collisions due to crowding on the road.

Interview participants

The author approached people waiting for the train and taking the train to conduct related interviews.

Interview contents

The interview content is divided into the following parts:

Part 1: Interview about basic information (age, income and travel distance)

Part 2: Interview about cost savings when taking the Metro

Formula to calculate savings level:

$$SL = \frac{CT \text{ before} - CT \text{ after}}{CT \text{ Before}}$$

Where: SL (Saving level): saving level; CT before = Cost of Transport before: Average cost of transportation for 1 month before switching to taking the train; CT after = Cost of Transport after: Average cost of transportation 1 month after switching to the train.

Specifically, the costs that can be mentioned are shown in the following table:

CT before = Cost of Transport before: Average travel cost for one month before switching to the sky train, including gasoline costs, repair and maintenance costs for personal vehicles, costs for taking a grab car, Cost of bus tickets and other related costs, if any.

CT after = Cost of Transport after: Average travel cost for one month before switching to the sky train, including buying train tickets (monthly or individual tickets), gasoline and maintenance costs for passengers. Besides, the travellers still have to use personal vehicles for other routes, which costs them common related costs. They also have to pay the cost of catching a car, buying bus tickets, and other related costs.

Part 3: Evaluation of economic motives compared to other motives when deciding to take a train

Participants were interviewed about pairwise comparison of motives according to the framework shown in the following table:

Table 1. Pairwise comparison

STT	Level	Compare pairs of importance levels	Explanatory content
1	1	Equal	This factor is as important as the other factor
2	3	Slightly	This factor is a bit more important than the other factor
3	5	Significantly more	One factor is significantly more important than the other
4	7	More	This factor is much more important than the other factor
5	9	Much more	This factor is much more important than the other factor

Source: Satty

Then, the results will be put into the pair matrix and calculated according to Satty's formula and only results with $CI < 0.1$ according to Satty's scale are valid.

Interview participants

Preliminary statistics about the subjects are shown in the following table

Table 2. Statistics of Metro riders

	Objects	Group	Numbers	Percentage
Age (AGE)	under 22 years old	1	27	28.13%
	22-25 years old	2	19	19.79%
	25-30 years old	3	22	22.92%
	Over 30 years old	4	28	29.17%
Income (INCOME)	Under 10 million/month	1	36	37.50%
	10-20 million	2	33	34.38%
	over 20 million	3	27	28.13%
Average distance travelled/day (DISTANCE)	< 10 km	1	23	23.96%
	from 10-15 km	2	28	29.17%
	from 15 - 20 km	3	20	20.83%
	> 20 km	4	25	26.04%

Source: compiled by the author

The distribution of characteristics among members of the sample is relatively even, implying that Metro participants are diverse and the sample meets the requirement of random.

4. Survey results

Results of research on economic savings of participants

Table 3. Statistical results on cost savings

No	Objects	Group	Average CT before	Average CT after	Average SL
Age (AGE)	under 22 years old	1	636.185	531.222	17.06%
	22-25 years old	2	614.947	502.211	19.23%
	25-30 years old	3	637.818	539.773	16.02%
	Over 30 years old	4	670.179	561.107	17.15%
Income (INCOME)	Under 10 million/month	1	685.08	574.72	16.99%
	10-20 million	2	614.85	514.64	17.04%
	over 20 million	3	618.70	511.04	17.95%
Average distance traveled/day (DISTANCE)	< 10 km	1	454.35	353.91	22.13%
	from 10-15 km	2	594.75	486.32	18.34%
	from 15 - 20 km	3	700.95	594.75	15.29%
	> 20 km	4	821.44	712.76	13.22%

Source: compiled by the author

The results indicate that the disparity in average expenses before and after, for each group reveals that the cost of daily transportation activities for the studied group constitutes around 10% of a typical Vietnamese labourer's wage (more than 7 million, according to the General Statistics Office, by February 2024). When switching to using Metro public transportation, they will reduce costs for using current vehicles, especially personal vehicles, and lose additional costs for taking the train, and the difference is the savings. Specifically, the additional costs for Metro are as follows: Metro train ticket price (according to statistics as of March 2024) is 9,000 - 24,000 VND/trip, and the 1-day ticket price is 48,000 VND. The 3-day ticket price is 108,000 VND. The monthly ticket price for

general passengers is 330,000 VND/month; for students, it is 165,000 VND/month. With that additional cost and cutting many costs related to previous travel, using Metro has saved about 15-20% compared to the average cost of the surveyed group.

Anova test results

After dividing the surveyed subjects into groups according to age, income, and distance criteria, the ANOVA test was used to evaluate the difference in cost savings. The results are shown in table 4.2-4.4 below:

The following tables show the One Way Anova test results for groups when divided by age (AGE), income (INCOME) and distance (DISTANCE).

Anova test results

Table 4. Anova test for pairwise comparisons when divided by age

Multiple Comparisons							
Dependent Variable: SL							
	(I) AGE	(J) AGE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	1	2	-2.1643%	1.5886%	.176	-5.319%	0.991%
		3	1.0415%	1.5237%	.496	-1.985%	4.068%
		4	-0.0890%	1.4309%	.951	-2.931%	2.753%
	2	1	2.1643%	1.5886%	.176	-0.991%	5.319%
		3	3.2058%	1.6615%	.057	-0.094%	6.506%
		4	2.0753%	1.5769%	.191	-1.056%	5.207%
	3	1	-1.0415%	1.5237%	.496	-4.068%	1.985%
		2	-3.2058%	1.6615%	.057	-6.506%	0.094%
		4	-1.1304%	1.5115%	.456	-4.132%	1.871%
	4	1	0.0890%	1.4309%	.951	-2.753%	2.931%
		2	-2.0753%	1.5769%	.191	-5.207%	1.056%
		3	1.1304%	1.5115%	.456	-1.871%	4.132%

Source: compiled by the author by SPSS

- In term of age, only groups 2 and 3 have a statistically significant difference with Sig < 0.05 when considering the savings when switching to Metro and group 2 is the group with greater value.

+ The group under 22 has a relatively unusual distribution of value among members of this group; the group 25-30 and the group over 30 years old have differences in the savings level of group members, resulting in not finding the typical behavior of these groups.

+ The 22-25-year-old group has the most similar savings levels, which is explained because the 22-25 group is considered the most potential customer group to benefit economically from this activity. This age group mostly starts school and

is finding and settling into a new job. Given the characteristics of the capital, which is considered a potential place to develop a career, many young people are trying to stay in Hanoi to look for jobs, so the frequency of movement of groups 22-25 within Hanoi is relatively high, continuous and for many purposes. Besides, this age group is also more willing to walk than other ages to save money travelling between stations, making switching to Metro transport the most significant savings for this group compared to other groups equally and statistically significantly.

+ The remaining groups have uneven savings levels among group members due to differences in travel behavior, and different members' expense levels will lead to the savings levels of members.

Table 5. Anova test for pairwise comparisons when divided by income

Multiple Comparisons							
Dependent Variable: SL							
	(I) INCOME	(J) INCOME	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	1	2	-0.0539%	1.2939%	.967	-2.623%	2.516%
		3	-0.9640%	1.3669%	.482	-3.678%	1.750%
	2	1	0.0539%	1.2939%	.967	-2.516%	2.623%
		3	-0.9101%	1.3933%	.515	-3.677%	1.857%
	3	1	0.9640%	1.3669%	.482	-1.750%	3.678%
		2	0.9101%	1.3933%	.515	-1.857%	3.677%

Source: compiled by the author by SPSS

When considering income, unlike the opinion that the lowest income group will save on transportation costs, the lowest income group habitually uses economical transportation methods (travelling by bus or walking), so switching to the Metro method stays the same as the cost savings of the group in the sample.

+ The group with an average income is a group with quite flexible moving behavior, and the movement of this group shows that the frequency of large and significant differences between group members should be the average value. The average does not reflect the group's behavior.

+ Groups with high incomes show that the experience of switching to Metro instead of the previous mode of travel comes from many reasons, such as convenience rather than economic purposes, so this shift does not create a significant.

Table 6. Anova test for pairwise comparisons when dividing by distance

Multiple Comparisons							
Dependent Variable: SL							
	(I) DISTANCE	(J) DISTANCE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
LSD	1	2	3.7925%*	1.1858%	.002	1.437%	6.148%
		3	6.8458%*	1.2883%	.000	4.287%	9.404%
		4	8.9120%*	1.2174%	.000	6.494%	11.330%
	2	1	-3.7925%*	1.1858%	.002	-6.148%	-1.437%
		3	3.0533%*	1.2336%	.015	0.603%	5.503%
		4	5.1195%*	1.1594%	.000	2.817%	7.422%
	3	1	-6.8458%*	1.2883%	.000	-9.404%	-4.287%
		2	-3.0533%*	1.2336%	.015	-5.503%	-0.603%
		4	2.0662%	1.2641%	.106	-0.444%	4.577%
	4	1	-8.9120%*	1.2174%	.000	-11.330%	-6.494%
		2	-5.1195%*	1.1594%	.000	-7.422%	-2.817%
		3	-2.0662%	1.2641%	.106	-4.577%	0.444%

*. The mean difference is significant at the 0.05 level.

Source: compiled by the author by SPSS

- When considering average travel distance:

+ Only group 3 and group 4 have no statistically significant difference; that is, the cost for travel activities is the same for the group moving from 15-20km/day, and the group moving over 20km/day can be considered the most significant sample. However, compared to previous transportation methods, there are too many differences among the subjects in the sample, and a relatively large group of subjects already use public transportation such as buses, causing the reduction to be insignificant. In contrast, another group rides personal motorbikes (wasting gas and depreciation) or a combination of buses and motorbike taxis.

+ Long distances mean that individuals will have many routes to travel and make costs quite flexible and different between group 3 and group 4 members, making it difficult to create statistical differences between these two groups.

+ However, compared to the other two groups, group 1 is the group that makes the most difference because the amount of money this group has to pay is already the lowest compared to the other groups. Similarly, group 2 is where the travel distance is the most reasonable for a typical worker. Choosing to switch to Metro brings benefits in terms of cost savings. Costs are similar in Group 2 but lower than in Group 1. The reason is not due to higher cost savings but rather due to lower savings on expenditure.

Economic factors and other factors affect the decision to switch to Metro

Using the AHP method to evaluate the contribution of the factors, we obtain the following table of results:

Table 7. Research results on weighted contributions of factors

STT		Explain
1	Economic motive	Want to save on travel costs
2	Convenient engine	If you want to avoid traffic jams, avoid rain and wind, you can take the time to work
3	Motivation for the environment	Actively choose green and public means to protect the environment
4	Motive for self-affirmation	Using green and public means is recognized by society as an act of contribution to the community
5	Motivation to follow the crowd	There is no specific motive, but just follow the crowd because you think it should be that way
6	Movement engine	Secondary motivation arises from having to travel between stations
7	Safe engine	Do not directly control the vehicle, avoid collisions

Source: compiled by the author

After pairwise comparisons in the matrix, the criteria rankings are calculated according to the AHP method as shown in the following table:

Table 8. Research results on weighted contributions of factors

No	Criteria	Label	Weighted
1	Economic motive	DR1	0.309459
2	Convenient engine	DR2	0.341598
3	Motivation for the environment	DR3	0.111536
4	Motive for self-affirmation	DR4	0.113112
5	Motivation to follow the crowd	DR5	0.058347
6	Movement engine	DR6	0.035561
7	Safe engine	DR7	0.030387

Source: calculated by the author

Reliability coefficient $CR = 0.07528 < 0.1$ means that the survey data is reliable and in ranking order;

The group of factors for the environment, self-affirmation or following trends ranked second. The group of secondary benefits, such as fitness and ensuring travel safety, ranked last

The characteristics of travelling in large cities like the capital, Hanoi, consume a considerable amount of time due to traffic jams, chaotic traffic, noise and dust pollution, and the primary means of transportation are primarily motorbikes, bringing quite a tiring and stressful personal experience. Switching to Metro trains helps people escape many personal experience problems, making people more motivated to move. Besides, the current means of transportation are mainly motorbikes; some take the bus, which also costs

little per month, making the savings from taking the train not the primary motivation for travelling.

5. Some suggestions and limitations of the study

- Thus, the economic motive is not the most significant motive to motivate behavior, but it is still vital (ranked second) in choosing behavior.

The difference in economic benefits through assessing the proportion of costs saved is most clearly shown when divided by the distance travelled. If more routes with more Metro can be built, better meeting the movement needs of many people with different levels of mobility, it will increase participation and attract more people. Increase economic benefits more synchronously and effectively, ensuring that no matter how much mobility the travellers have, they can still participate in the system and gain significant benefits.

To develop railway routes, we can start by studying the schedules of groups of people who have the habit of travelling by public transport such as buses and grasp the proportions, schedules and distances of this group of people to optimize alternative Metro transportation for this group. At that time, buses will become more of a means of transit than a means of transporting, reducing pressure on the traffic system in large urban areas, limiting traffic congestion, and increasing all economic, societal and environmental efficiency.

- The age and income of the interviewed group show a rotation between young school graduates and middle-income groups; this can be considered the leading customer group in Hanoi, where the majority are renters and choose a flexible place to work and live. However, they are affected by the difference in rental prices in central and sparsely populated areas. They are affected by continuous job elimination (being laid off or proactively changing jobs). Therefore, this route may suit the needs of this group during this period but may serve other customers in the future, and the current customer group might change their living place, resulting in its use is no longer appropriate.

Therefore, to ensure the stability of the income source from a stable number of loyal customers, the most optimal solution is to increase the number of construction routes to meet the fluctuating needs of customer activities.

However, in a short period, that is impossible. A temporary solution for the short term is to increase the retention of old customers through incentives and promotions and try to expand the new customer base; they can increase new customers by increasing vouchers/point reward cards for those working and studying along the existing railway routes.

- The motivation at the top of the list is this vehicles' convenience, such as space to rest while travelling, avoiding traffic jams, and saving time. These motivations are long-term values that the system should bring to customers.

It is necessary to specifically enhance additional utilities, which can be mentioned as derivative services (possibly through the form of a contractor or as a side business activity of the company) within the train compartment or may be related to the passenger waiting area.

One of the accompanying integrated values is that many places build convenience stores or fast-food services, adding motivation and surplus value to travel, saving customers' time and creating additional sources of income for suppliers.

References:

- Potting, J., Hekkert, M., Worrell, E., Hanemaaijer, A., (2017). 'Circular Economy: Measuring innovation in the product chain', p:
- Kirchherr, J., Reike, D., Hekkert, M., (2017). 'Conceptualizing the circular economy: an analysis of 114 definitions', *Resour. Conserv. Recycl.*, 127: p:
- Profillidis, V.A., & Botzoris, G. N., (2018). 'Modeling of transport demand: Analysing, calculating, and forecasting transport demand', Elsevier Press., p:
- Burge, P., Fox, J., Kouwenhoven, M., Rohr, C., & Wigan, M. R., (2008). 'Modeling of motorcycle ownership and commuter usage: A UK study', *Transportation Research Record Journal of the Transportation Research Board*, 2031: p: 59-68.
- Santos, G., Maoh, H., Potoglou, D., & von Brunn, T., (2013). 'Factors influencing modal split of commuting journeys in medium-size European cities', *Journal of Transport Geography Journal*, 30: p: 127-137.
- Franco, P., Johnston, R., & McCormick, E., (2019). 'Demand responsive transport: Generation of activity patterns from mobile phone network data to support the operation of new mobility services', *Transportation Research Part A: Policy and Practice*, 131: p: 244-266.
- Van, T.H., & Fujii, S., (2011). 'A cross Asian country analysis in attitudes toward Car and public', *Journal of the Eastern Asia Society for Transportation Studies*, 9: p: 411-421.
- Mo, C., Kwon, Y., Park, S., (2014). 'Current status of public transportation in ASEAN megacities', *The Korea Transport Institute (KOTI)*, p:
- Beirao, G., & Sarsfield Cabral, J. A., (2007). 'Understanding attitudes towards public transport and private', *Transport Policy*, 14: p: 478-489.
- Le, L.P.T., & Trinh, T. A., (2016). 'Encouraging public transport use to reduce traffic congestion and air pollutant: A case study of Ho Chi Minh City, Vietnam', *Procedia Engineering*, 142: p: 236-243.
- Domencich, T., & McFadden, D. L., (1975). 'Urban travel demand: A behavioral analysis.', *North-Holland Publishing Co.*, p:
- Bamberg, S., Hunecke, M., & Blobaum, A., (2007). 'Social context, personal norms and the use of public transportation: Two field studies', *Journal of Environmental Psychology*, 27: p: 190-203.
- Hidayati, I., Tan, W., & Yamu, C., (2020). 'How gender differences and perceptions of safety shape urban mobility in Southeast Asia', *Transportation Research Part F: Traffic Psychology and Behaviour*, 73: p: 155-173.