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THE EFFECT OF REBOUND EFFECT ON SUSTAINABLE TRANSPORTATION DEMAND

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Overview

Increasing the efficiency of vehicles is an important method of reducing the fuel consumption and motor vehicle emissions. On the other hand, increasing fuel efficiency would lead to reduction in the per mile cost of driving and it tends to increase the total vehicle mileage. This is called rebound effect. The rebound effect will result in an increase in emissions due to the increased vehicle travel.
Another consequence of rebound effect is that the rate of annual increase of passenger and freight transport service is more than increasing the number of vehicles.
The extent of the rebound effect varies depending on many factors, but it often reduces the effectiveness of a policy.
Greene concludes that the long-term impact of rebound effect is 20%. In other words, if increasing fuel economy reduces the cost of fuel by 10% per mile of travel, travel increases by 2%.
The present paper is supposed to investigate the rebound effect through a case study that will be the analysis of energy consumption and emission of pollutants in the transport sector of Iran and the impact of rebound effect.

Methods

Energy consumption by each system is estimated through following equation:

$$E_{i,t} = EI_{i,t} \times A_{i,t} \qquad (1)$$

In which $EI_{i,t}$ is the energy intensity of transport mode i at the t time and $A_{i,t}$ represents the activity level of the transport mode.
Increased energy efficiency of a vehicle would lead to reduction in the fuel consumption and motor vehicle emissions. In fact, when new vehicles with higher efficiency are added to the transportation fleet, the average fuel consumption of the whole fleet would decrease. But relative reduction in operation cost of vehicles would result in more transportation and more energy consumption than before (rebound effect).

To investigate the magnitude of rebound effect, level of service should be independent of efficiency of transportation fleet. Thus; assumption of constant level of service would be acceptable. So the expected energy consumption could be calculated by:

$$E_{i,t} = EI_{i,t} \times A_{i,t-1} \qquad (2)$$

The estimated rebound effect is a function of many parameters such as:

$$\text{(REBOUND)} = \psi(INCOME, POP, TRANSPORTCOST, FLEETAVERAGEOLD) \qquad (3)$$

In which REBOUND is the rebound magnitude, INCOME is income by householders, POP is the population of case study, TRANSPORTCOST is the transportation cost and FLEETAVERAGEOLD is the average old of transportation FLEET in IRAN.

Results

The function ψ shows the relationship between rebound effect and assumed parameters. The value for the assumed function is listed in table 1.

Variables	Elasticity	Probability
LOG(REBOUND)	---------------	----------------
LOG(INCOME)	10.11471	0.0119
LOG(POP)	-141.2918	0.0589
LOG(TRANSPORTCOST)	-12.86223	0.0561
LOG(FLEETAVERAGEOLD)	-15.88092	0.0940

Table 1

According to table 1, income will affect the rebound effect in positive direction. It means that, the more income for the consumers, the more rebound effect will take place.
The most effective parameter in opposite direction for rebound effect is population. It means that the rebound effect is negligible in low-populated areas.

Conclusions

In order to investigate the exact result of transportation strategies, the rebound effect should be considered.
The main objective of the present paper is to examine how exogenous technological progress, in terms of an increase in energy efficiency, affects consumption choice by Iranian households.
The results show that household income has considerable impact on rebound magnitude.

References

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