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Evaluation of the Fuel Conversion Program in Vehicles in the Aburrá Valley (Colombia)

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Emissions from mobile sources are an important environmental problem in the main cities of Colombia, and other Latin-American cities as well. The Aburra Valley in Colombia includes Medellín and nine municipalities. This area has high air pollution levels, and at some points the legal maximum levels of emissions are exceeded, with a high impact on human well-being. It is estimated that around 65% of the total emitted pollutants come from mobile sources. Therefore, environmental policy that aims to improve air quality should at least focus on changing the behavior of car owners, including the type of technology they use in their cars.

Empresas Públicas de Medellín (EPM), the public enterprise that provides public domestic services (energy, water, water disposal and telecommunications) in the Aburra Valley, started in 2001, together with ECOPETROL, a program to encourage the use of natural gas in vehicles (NGV) in the Aburra Valley, with incentives to convert light-duty cars from gasoline and diesel to hybrid engines combining both NGV and gasoline or diesel. As part of this program, about 10% of small vehicles in the study area have been converted. The total amount of the number of converted vehicles has increased exponentially, from 652 vehicles in 2001 to 22,000 in 2007. This increase is linked to an increment in the subsidy from COP$400,000 (US$200) in 2004, to COP$1,000,000 (US$500) in 2007. Interestingly, despite the availability of incentives, almost 20% of vehicles have been converted without the subsidy.

The aim of this research project was to find out the determinants of the decision to switch to natural gas in vehicles in the Aburra Valley, and in this manner to go further beyond the simplistic preconception that owners were converting their cars just because of the subsidy or simply because natural gas is a cheaper fuel compared to gasoline. In a period of high oil prices, this issue is a concern for both the energy and the automotive sectors. Hence, this work gives some insights about the adoption of this type of technologies in vehicles, and also offers some information for a more general discussion on the implication of using economic incentives to encourage alternative fuels.

Using a random utility model framework, we estimated a probit model for the analysis of the conversion decision using a sample of 673 owners with either a converted or a non-converted car, who were interviewed in fueling stations located at the study zone. From the estimation we can conclude that the switch to natural gas in vehicles was generated not only by the lower price of this fuel, as it is stated by users, but also by other factors such as the type of use of the car, the engine size, the number of kilometers driven, and the conversion costs. Thus, a commercial vehicle with relatively high engine size and low conversion cost is very likely of being switched to natural gas. This is linked to the fact that the bigger the engine's car, the more the fuel expenditure the owner has if no conversion takes place, and therefore, the higher the money savings risen once the vehicle has been converted. And also, to the fact that a car that is driven for a high range of kilometers could have a lower payback period than a car that is just used for commuting reasons; period that could be even shorter if the conversion costs are low –which corresponds to vehicles manufactured before 1998–. This model also showed not significant impact of the distance from either the owner's home or job place to either the gas station where he was interviewed or the nearest fueling station to one of the owner reference locations. That is, the owners do not see the lack or not of close fueling stations as a determinant for the switching decision, as long as, we would say, the switched vehicle is used for transportation inside the Aburra Valley.

From the survey, we also found that the mean of the minimum stated amount of subsidy required for switching, by converters and non-converters, are COP$454,320 and COP$1,391,200, respectively. This could suggest that there is no need to set up a subsidy as high as it has been done in the last years. In fact, the lower price of natural gas has worked as an economic incentive per se. Hence, the initial amount of this incentive (COP$400,000) could have been kept constant, and instead an incentive on the supply could be established. Such incentive could be addressed to creating new fueling stations in the northern zone of the Aburra Valley, where very few stations currently exist, and also trigger or award the good administration of the workshops towards the promotion of this fuel. This might create distinction and reputation for the workshop's owner and his business, and also would be a signal for owners interested in such a technology.

Table 1. Probit estimates for NGV Conversion

Variable	Coefficients	P-value
Number of Cars	0.02	0.814
Engine Size	0.05**	0.000
Km	0.48**	0.000
Commercial Vehicle	-0.62**	0.000
Cost	-0.49**	0.002
Price Expectation	-0.17	0.130
Station	-0.1	0.443
Knowledge	0.19	0.234
Year	-0.36	0.701
Education	-0.12**	0.000
Income	0.04	0.235
Heads	-0.03	0.713
No-heads	-0.06	0.583
Constant	7.75	0.670
Distance_home	0.007	0.868
Distance_job	-0.002	0.963
Distance_home_c	-0.02	0.259
Distance_job_c	-0.03	0.294
Number of observations	528	
Likelihood ratio	143.1	
Pseudo-R^2	0.2	

* significant at 5%; ** significant at 1%

Given that most of the converted vehicles have a medium engine size and are relatively old (i.e., they are more than 10 years old), it can be argued that the program could be having a good effect in terms of avoided emissions of air pollutants. Therefore, environmental policy that aims to improve air quality or encourage alternative fuels should focus on changing the behavior of owners in the type of engine fuel technology they use. This target could be reached not only through economic incentives to the final users, as it is usually proposed in the literature, but also considering other links of the natural gas chain such as the distribution of this fuel and the suppliers of the new technology.

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