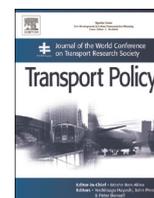




ELSEVIER

Contents lists available at ScienceDirect

Transport Policy

journal homepage: www.elsevier.com/locate/tranpol

Simulating the market penetration of cars with alternative fuelpowertrain technologies in Italy

Eva Valeri*, Romeo Danielis

Department of Economics, Business, Mathematics and Statistics (DEAMS), University of Trieste, P.le Europa, n. 1, 34100 Trieste, Italy

ARTICLE INFO

Article history:

Received 26 February 2014

Received in revised form

16 July 2014

Accepted 10 October 2014

Available online 11 November 2014

Keywords:

Car choice

Market scenario

Stated preference

Discrete choice

Policy simulation

ABSTRACT

This paper evaluates the market penetration of cars with alternative fuelpowertrain technologies in Italy under various scenarios. Seven cars on sale in 2013 are considered: the Ford Fiesta (diesel), the VW Polo (gasoline), the Fiat Punto Evo (bi-fuel – CNG), the Natural Power Alfa Romeo Mito (bi-fuel – LPG), the Toyota Yaris (hybrid – gasoline), the Peugeot iOn (BEV – owned battery), the Renault Zoe (BEV – leased battery). A Mixed Error Component Logit model is estimated based on data collected via a *stated preference* choice survey administered in 2013 in various Italian cities. The model's parameters are then used to build a Monte Carlo simulation model which allows evaluating, under different scenarios, the market penetration of the seven cars. The main findings are that (a) the subsidies enacted by the Italian government in favour of the low CO₂ emitting cars appear to favour mostly the Ford Fiesta (diesel); (b) a three-fold increase in the BEVs range would not change their market share significantly (about 2%); and (c) only a combination of changes such as the introduction of a subsidy equal to €5000, the decrease of the purchase price for BEVs by €5000, the increase in the battery range, and the increase in the conventional fuel price would significantly increase the BEVs' market share, raising it to about 15%.

© 2014 Elsevier Ltd. All rights reserved.

1. Introduction

The car market is extremely diversified by segment and by fuelpowertrain technology. Auto manufacturers continuously improve their models and increase their differentiation in an effort to satisfy customers' needs, to gain a competitive edge over their competitors and to meet the various energy and environmental regulatory constraints. An interesting recent development is the process of electrification that is gradually gaining momentum in the passenger car market. The hybrid, the plug-in and the battery electric vehicle (HEV, PHEV, BEV) are the new entrants in the car market with gradually growing market shares, with the hydrogen fuel cell vehicles (HFCV) in the process of going from the concept stage to the manufacturing one. These engine technologies, together with the Compressed Natural Gas vehicles (bi-fuel CNGV) and the Liquefied Petroleum Gas Vehicles (bi-fuel LPGV) ones, make up what is known as Alternative Fuel Vehicles (AFV) as

Abbreviations: ; AFV, alternative fuel vehicle; BEV, battery electric vehicle; BV, biofuel vehicle; CNGV, compressed natural gas vehicle; CV, conventional vehicle (including SGV and DV); DV, diesel vehicle; HEV, hybrid electric vehicle; HFCV, hydrogen fuel cell vehicle; LPGV, liquefied petroleum gas vehicles (bi-fuel); SGV, standard gasoline vehicle

* Corresponding author.

E-mail addresses: eva.valeri@econ.units.it (E. Valeri), danielis@econ.units.it (R. Danielis).<http://dx.doi.org/10.1016/j.tranpol.2014.10.003>

0967-070X/© 2014 Elsevier Ltd. All rights reserved.

opposed to the more traditional and largely established gasoline and diesel cars.

In our view, in relation to these developments, there are some very relevant research questions such as: how will the consumers react to the new fuelpowertrain technologies? Will they gradually penetrate the market and with which speed? In which market segments? Do public policies interested in gaining independence from oil, reducing energy consumption or local and global pollution influence consumers' choices and by how much? All these questions are of great significance to the auto manufacturers, to the policy makers and to the general public and, most likely, the answers will be quite differentiated among countries and population segments. The discrete choice methodology, based on data collected at individual level on both stated and revealed choices, is a largely established methodology which could help understand and predict consumers' choices.

Our specific interest is to provide some answers for the Italian car market, a task not yet performed in the scientific literature. Compared with other western countries, Italy appears to be lagging behind in the penetration of the AFVs, though having high air and noise pollution levels and a strong economic dependence from oil imports. Only bi-fuel CNGVs and bi-fuel LPGVs have recently gained relevant market shares in some regions of the country.

This paper focuses on seven specific cars on sale in Italy with the following fuelpowertrain technologies: the Ford Fiesta (diesel), the VW Polo (gasoline), the Fiat Punto Evo (bi-fuel – CNG), the

Natural Power Alfa Romeo Mito (bi-fuel – LPG), the Toyota Yaris (hybrid – gasoline), the Peugeot iOn (BEV – owned battery), the Renault Zoe (BEV – leased battery). The data collected via a *Stated Preference* (SP) choice survey and administered in 2013 in three Italian cities are used to estimate a Multinomial Logit (MNL) model and a Mixed Error Component Logit (MECL) model. The estimated parameters are used in a Monte Carlo simulation model to evaluate, under different scenarios, the potential market penetration of the seven cars in Italy.

Notwithstanding the national dimension of the market analysed, the techniques used in the paper to collect the data, to estimate the econometric model and to perform policy simulation represent a potential contribution to the international literature, and the results obtained might be of interest not only for the Italian policy makers.

The paper is organised as follows: a review of the literature is presented in [Section 2](#); the SP experiment is illustrated [Section 3](#), the descriptive, econometric and simulation results are reported and discussed in [Section 4](#), and the conclusions and policy implications are drawn in [Section 5](#).

2. Literature review

Car choice and its use is certainly not a new topic. It has been studied extensively since the pioneering contributions by [Love and Train \(1979\)](#), [Manski and Sherman \(1980\)](#), [Berkovec and Rust \(1985\)](#). Yet, it is still a difficult topic as the paper by [Daziano and Chiew \(2012\)](#) theoretically, methodologically and empirically demonstrates. From a theoretical point of view, the car is a durable good to be used for mobility reasons but with obvious social and cultural implications. The importance attributed to the car changes over time and varies among individuals: from a symbol of independence of the early years, to a status symbol of driving a Ferrari or a SUV, to a mere tool to be used and not owned with carsharing. Car choice is also a family matter, discussed with the other family members, in a context where more than one car is available. From a methodological point of view, various approaches has been used to study car choice and car use, including (macro) time series analysis, (macro) diffusion models, (micro) economic preference models and attitudinal (hybrid) models. Empirically, with special reference to the last two types of models, and considering the newly introduced engine technologies (hybrid, plug-in, electric, fuel cell) the SP data have prevailed over the *revealed preference* ones, simply because these are a not yet-existing- or sufficiently widespread technology.

The focus of this review is on the economic preference and attitudinal (hybrid) models, based on individual data, aimed at forecasting or policy analysis more than at analysing the preference structure.

[Table 1](#) lists some recent studies focusing on forecasting market penetration. [Qian and Soopramanien \(2011\)](#), with reference to the Chinese market, reach the conclusion that the Chinese consumers are more likely to consider switching from SGVs to HEVs than to BEVs. [Mabit and Fosgerau \(2011\)](#) estimated a ML model with four alternatives (CV, HFCV, HEV, BV, BEV) and performed a market penetration analysis taking into account the CV and the BEV. They reach the optimistic conclusion that the BEV could gain a market share between 48% and 72%. On the contrary, [Link et al. \(2012\)](#) predict that the BEVs could increase in Austria to a modest 2.5% in 2020 and to 5.7% in 2025, whereas HFCVs have a considerable higher potential (11.5%). [Glerum and Themans \(2011\)](#) use a logit model to analyse the market potential of the Renault cars compared to the other brands. They conclude that the Renault BEVs have a stronger potential than the conventional Renault cars. [Jensen et al. \(2014\)](#) add to the hybrid model a diffusion model in

Table 1
Overview of selected SP studies on consumer preferences and market penetration of AFVs.

Authors	Methodology	Car types	Attributes	Forecasting market penetration
Qian and Soopramanien (2011)	SP MNL and NL model	SGV, HEV, BEV	Purchase price, annual running cost, incentives, availability of charging facilities, vehicle range with full charging	Chinese consumers are more likely to consider switching from SGVs to HEVs than to BEVs.
Mabit and Fosgerau (2011)	SP Mixel Logit Model and simulation	CV, HFCV, HEV, BV, BEV	Purchase price, annual cost, Range, refuelling frequency, acceleration time, service	In forecasting analysis only two car types are compared (CV and BEV). The results from "Expected" scenario A show that BEVs obtain a market share of 48%. In "Probable" scenario B this market share has increased to 72%.
Link et al. (2012)	SP Multinomial Logit Model	CV*, HEV, BEV	Purchase price, range, charging time, running cost, CO ₂ emission, engine power	Austrian consumers prefer CVs compared with both BEVs and HEVs. They estimate a new car market share of 0.04% and 0.7% for HEVs (2010). Forecasting predict a BEVs market increase to 2.5% in 10 years (2020) and to 5.7% after 15 years (2025). HEVs have a considerable higher share compared with the BEVs (11.5%).
Glerum and Themans (2011)	SP logit choice model and Renault market data	CGV, Renault CV, Renault BEV	Purchase price, cost of driving 100 km, governmental incentive, monthly cost of leasing the BEV battery	The market share of CGV is 68.3%, Renault CV (gasoline or diesel) cars is 4.6%, Renault BEVs is 27.1%.
Jensen et al. (2014)	Hybrid choice and diffusion model	CV, BEV	Purchase price, driving distance, driving costs, driving performance, CO ₂ emission, charging options, EV battery lifetime	In Denmark a 3% BEV market share is not reached until 2021 but after this year, a higher increase is seen each year. The highest increase in the share of adopters is seen in 2023 (6%).

Notes: conventional vehicles (CV, including SGV and DV), * = own vehicle.

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات