The Impact of Macroeconomic Indexes on Automobile demand: a Panel Data Econometric Analysis

Elaheh Kimia[1], Amir Mansour Tehranchian[2]

[1]MBA Graduate from Mazandaran University of Science and Technology, Iran
Elahe_kimia@yahoo.com
[2]Associate Professor of Economics, Department of Economics, University of Mazandaran, Iran
m.tehranchian@umz.ac.ir

Abstract: In this paper, the impact of some major macro-economical indexes on Iran automobile demand will be surveyed. For this reason, the suggested logarithm model estimated by use of the data census of the Iranian automobile companies (2001-2009). According to the Limer's F test results, it had been specified that the difference in cross-sections is meaningful statistically. Also, the Hausman test showed that the difference in cross-sections is random. The results of the model's estimation by the random effect test showed that the implementation of the expansionary monetary and fiscal policy, the Gini coefficient reduction, and the economic growth have positive and meaningful effect on automobile demand.

[Elaheh Kimia, Amir Mansour Tehranchian. **The Impact of Macroeconomic Indexes on Automobile demand: a Panel Data Econometric Analysis.** *Rep Opinion* 2016;8(11):88-91]. ISSN 1553-9873 (print); ISSN 2375-7205 (online). http://www.sciencepub.net/report. 8. doi:10.7537/marsroj081116.08.

Keywords: Automobile Demand, Liquidity, Government Expenditures, Gini Coefficient, Economic Growth

1. Introduction

A noticeable part of marketing and economics literature has been allocated to the analysis of consumer behaviors. In this extent, the reactions of consumers to the variables that have effects on their subjective preferences or their purchasing capabilities have been studied. Advertizing, expectations, and relative prices are the variables that have been entered to the models traditionally. Hence, the demand function is in fact the consumer's reaction function. This response takes place against the changes in macro-indexes besides the reaction to the micro-indexes changes. In real world, adoption of macro policies like taxes increase or government expenditure reduction has impact on the behavior of economics' elements. An economic agent even a producer or a consumer is an agent that maximize the profits. So, it's obvious that as for the macro-indexes changes have effects on the outflow of the maximization of the profits, it impacts the stated unites behavior.

In this research, as a case study, the impact of macro economical indexes on automobile demand in Iran will be examined by the use of panel data related to automobile demand in Iran (2001-2009). For this purpose, this paper has been organized in five sections. In second section, some empirical evidence will be introduced. In third section, the methodology will be presented. Fourth section has been allocated to research findings and in the last part conclusions and suggestions will be stated.

2. Empirical evidence

In 1998, Dargay and Gately studied income's effect on worldwide car and vehicle ownership in the period of 1960-2015. They estimated short- and long-run income elasticity of car and vehicle ownership in their research. They found that income elasticity depend upon per-capita income [2]. Then Dargay(2002) examined the factors determining car ownership for households living in rural and urban areas by using a pseudo-panel approach, based on data from Family Expenditure Surveys in the UK for 1982–1995. The implication of the results of his research is that general increases in the costs of car transport would pose a considerable economic burden for rural households [6]. In 2004, by using a pooled 90-country model Storchmann showed that distributional variables are highly significant to explain the demand for automobiles. He used Lorenz curves in his research and showed that the acquisition of an automobile is crucially dependent on the fraction of the population being above a critical income threshold. It is shown that on the one hand, in poor countries an unequal income distribution is needed to enable at least some people to buy automobiles. On the other hand, in wealthy countries an unequal income distribution would exclude some people from acquiring automobiles. Hence, depending on the income level, inequality has a diverging impact on the ability to buy durable goods [8]. Matas and Raymond in 2007 surveyed Changes in the structure of car ownership in Spain. Their empirical results show that income elasticity is not constant and declines as car ownership increases. Besides, households living in rural areas are less income sensitive than those living in urban areas.

Car ownership is also sensitive to the quality of public transport for those living in the largest cities. Their results also confirm the existence of a generation effect, which will vanish around the year 2020, a weak life-cycle effect, and a positive effect of employment on the number of cars per household. Finally, they showed that the change in the estimated coefficients over time reflects an increase in mobility needs and, consequently, an increase in car ownership [5]. Then, Liddle in 2008 showed that in the US mobility demand has a long-run systemic, mutually causal relationship with gasoline price, income, and vehicle ownership by using US data from 1946 to 2006. He found that those variables co-evolve in a transport system; and thus, they cannot be easily disentangled in the short-run. Also the fuel standards program was effective in improving the fuel economy of the US vehicle fleet and in temporarily lessening the impact on fuel use of increased mobility demand [4]. In the same year, Chen, Esteban and Shum studied the competition in the U.S. automobile secondary market. By using aggregate data from the U.S. automobile industry and measuring transaction costs and the substitutability between products they showed that when transaction costs are reduced and the secondary market becomes more active, firms are forced to decrease their production and charge a lower price, indicating that in this case the secondary market constitutes strong competition to the primary market and reduces demand for new products and hence firms' products. Also they found that opening the secondary market by reducing the transaction costs is more detrimental (less beneficial) to new good producers [1]. In a research in 2010, Nolan examined the determinants of household car ownership, using Irish longitudinal data for the period 1995–2001. She found income and previous car ownership to be the strongest determinants of differences in household car ownership, with the effect of permanent income having a stronger and more significant effect on the probability of household car ownership than current income. In addition, income elasticity is different by previous car ownership status, with income elasticity higher for those households with no car in the initial period. Other important influences include household composition (in particular, the presence of young children) and lifecycle effects, which create challenges for policymakers in seeking to change travel behavior [7].

3. Methodology

In this research we study the demand of eight different cars in the time series of 2001-2009. This time period and frequency is largely dictated by the availability of data. Data of liquidity, total government expenditure, GDP, tax income, economic growth rate, and gini coefficient are gotten from Central Bank. Also, the data of cars' prices and demand quantity are received from two of the largest car companies which are Iran khodo Industrial Group and Saipa Corporation.

The model to be estimated on panel data for eight different cars in this research is:

$$\text{Log}\,(d_{it}) = \alpha_0 + \alpha_1 \log\,(p_{it}) + \alpha_2\,(l_{it}) + \alpha_3 \log\,(tge/gdp_{it}) + \alpha_4 \log\,(ti/gdp_{it}) + \alpha_5 \log\,(egr_{it}) + \alpha_6 \log\,(gc_{it}) + U_{it} \quad (1)$$

Where in this model:

d = the demand quantity of cars

p = price of the cars

l = liquidity

tge/gdp = the ratio of total government expenditure to the current price of gross domestic products

ti/gdp = the ratio of tax income to the current price of gross domestic products

egr = economic growth rate

gc = Gini coefficient

In general a regression model of panel data is as follow:

$$Y_{it} = \alpha_i + \beta X_{it} + U_{it} \quad (2)$$

i= 1,2,…,N; t=1,2,…,T; $U_{it} = \mu_i + v_{it}$

Which i denotes households, individuals, firms, countries, etc. and t denotes time. The i subscript, therefore, denotes the cross-section dimension whereas t denotes the time-series dimension.

Where E($\mathbf{U_{it}}$)=0 and have constant variance. $\mu_\mathbf{i}$ Includes fixed effects that show difference between individual, households or countries especial characteristics (unobservable individual-specific effect) and $\mathbf{v_{it}}$ denotes the remainder disturbance.

First we test heterogeneous between sections by F-statistic. If null hypothesis isn't accepted, we use panel data. F-statistic and null hypothesis are [3]:

$$H_0: \mu_1 = \mu_2 = \cdots = \mu_{N-1} = 0 \quad (3)$$
$$H_1 = Not \quad H_0$$
$$F_0 = \frac{(RRSS-URSS)/(N-1)}{URSS/(NT-N-K)} \sim F_{N-1,N(T-1)-k}$$

RRSS: Restricted Residual Sums of Squares being that of OLS on the pooled model

URSS: Unrestricted Residual Sums of Squares being that of the LSDV regression

N: numbers of sections

K: numbers of explanatory parameters

The result of Limer's F test for this research is 20.85 and is bigger that the table's F so we should choose Fixed Effect or Random Effect. Then for choosing between Fixed Effect (F.E.) and Random Effect (R.E.) models we used Hausman Test:

$$H=(b_s-\beta_s)'(M_1-M_0)^{-1}(b_s-\beta_s)\approx\chi_k^2 \quad (4)$$

$$H_0: E(U_{it}|X_{it})=0$$

H_1: Not H_0

Where in this equation:

$\mathbf{M_1}$ = covariance matrix for coefficients of F.E. model ($\mathbf{b_s}$)

$\mathbf{M_0}$ = covariance matrix for coefficients of R.E. model (β_s)

In this study, according to the result of Hausman test we run the regression with Random Effect model (EGLS method). The table 1 presents the cross-section random effect test of regression results with the method of Panel Least Squares.

4. Findings

According to the information in the table 1, except the car price other variables are statistically meaningful at the level of 5% error or less than it. Also the car price is statistically meaningful at the confidence level of 80%. In fact, the coefficients in table 1 are elasticity coefficient of car demand quantity in respect of independent variables. The elasticity of the ratio of total government expenditure to the current price of GDP, and economic growth rate are positive and significant. The elasticity of car price is negative and insignificant. The elasticity of liquidity, the ratio of tax income to the current price of GDP, and Gini coefficient are negative and significant. Accordingly, 1% increase in liquidity decreases the car demand quantity (4.83 E -7) × $\mathbf{l_{it}}$ or in other word (4.83 E -7) times of the same year liquidity. Moreover, if the ratio of the total government expenditure to the current price of GDP increases 1%, the car demand quantity would increase 1.4%. The information in the table 1 shows that 1% increase in economic growth rate increases car demand quantity 1.1%. Furthermore, 1% increase in car price decreases its' demand 1.1%. Also, if the ratio of tax income to the current price of GDP increases 1%, the car demand quantity would decrease 1.3%. Besides, the results in table 1 show that 1% increase in Gini coefficient decreases the car demand 16.3% which is a high quantity. Coefficient of determination in this model is 88%. In other words, 88% of car demand fluctuations are explained by the dependant variables in the suggested model.

Table 1: Cross-section random effects test results

Dependent Variable: log(d) Method: Panel Least Squares Sample: 2001 2009 Included observations: 9 Cross-sections included: 8 Total pool (balanced) observations: 72				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
α	4.065230	7.982550	0.509265	0.6125
Log(p)	-1.108027	0.978505	-1.132368	0.2621
Log(l)	4.83E-07	9.89E-08	4.888409	0.0000
Log(tge/gdp)	1.421085	0.662350	2.145521	0.0361
Log(ti/gdp)	-1.341739	0.671429	-1.998333	0.0504
Log(egr)	1.109624	0.269192	4.122052	0.0001
Log(gc)	-16.33231	5.380502	-3.035462	0.0036
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.879093	Mean dependent var	4.698493	
Adjusted R-squared	0.851993	S.D. dependent var	0.488952	
S.E. of regression	0.188108	Akaike info criterion	-0.330934	
Sum squared resid	2.052310	Schwarz criterion	0.111751	
Log likelihood	25.91362	Hannan-Quinn criter.	-0.154700	
F-statistic	32.43894	Durbin-Watson stat	1.350604	
Prob(F-statistic)	0.000000			

5. Conclusions and Remarks

In marketing literature, in fact the demand function for a product explains the consumers' reaction toward the variables that influence on their subjective preferences or their purchasing capabilities. On this score, studying the impact of macro-indexes on demand is so important since macro-policies are influential on the process of optimizing consumers' behavior. In this research, as a case study, the impact of some major macro-indexes on automobile demand in Iran has been studied. For this purpose, the model of car demand function has been estimated with the panel data regression method. According to obtained results, the increases in car price and taxes, decreases the car demand. Also, the results show that the increasing in economic growth rate, liquidity, and government expenditure (expansionary monetary policy), increases the car demand quantity. The outputs of the estimation show that car demand is elastic toward the macro-indexes. Noticing the impressibility of the stated industry from macro-indexes and according to the result of this study, policy makers' attention to the impact of macro-policy part is among the indecision point. Equity in income distribution and adoption of expansionary monetary and fiscal policy in macro-level influence the consumers' behavior toward the increase in automobile demand quantity.

Corresponding Author
Elahe Kimia
#519-shahid bahonar street-part2-farhang shahr-babol-mazandaran-Iran, Postal code: 47167-19569
E_mail: elahe_kimia@yahoo.com

References

1. Chena, Jiawei, Estebanb, Susanna and Shumc, Matthew (2008): “How Much Competition is a Secondary Market?”, [a]Department of Economics, University of California, Irvine, [b]Department of Economics, Universidad Carlos III de Madrid, cDepartment of Economics, Johns Hopkins University.
2. aDargay, Joyce and bGately, Dermot (1998): “Income's effect on car and vehicle ownership, worldwide: 1960-2015”; aESRC Transport Studies Unit, Centre for Transport Studies, University College London, Gower Street, London WC1E 6BT, UK, bEconomics Department, New York University, 269 Mercer Street, New York, NY 10003, USA; Transportation Research Part A 33 (1999) 101-138.
3. H. Baltagi, Badi; " Econometric analysis of panel data"; third edition, 2005, John Wiley & Sons Ltd.
4. Liddle, Brantley (2008): ” Long-run relationship among transport demand, income, and gasoline price for the US”; Victoria University, Level 13, 300 Flinders St., Melbourne, VIC 8001, Australia; Transportation Research Part D 14 (2009) 73–82.
5. Matasa, Anna and Raymondb, Josep-LLuis (2007): “Changes in the structure of car ownership in Spain”, aDepartament d’Economia Aplicada, Universitat Auto`noma de Barcelona, 08193 Bellaterra, Barcelona, Spain, bDepartament d’Economia i Histo` ria Econo` mica, Universitat Auto`noma de Barcelona, 08193 Bellaterra, Barcelona, Spain; Transportation Research Part A 42 (2008) 187–202.
6. M. Dargay, Joyce (2002): “Determinants of car ownership in rural and urban areas: a pseudo-panel analysis”; ESRC Transport Studies Unit, Centre for Transport Studies, University College London, Gower Street, London WC1E 6BT, UK; Transportation Research Part E 38 (2002) 351–366.
7. Nolan, Anne (2010): ” A dynamic analysis of household car ownership ”, Economic and Social Research Institute, Whitaker Square, Sir John Rogerson’s Quay, Dublin2, Ireland; Transportation Research Part A; www.elsevier.com /locate/tra.
8. Storchmann, Karl (2005): " Long-Run Gasoline demand for passenger cars: the role of income distribution "; Economics Department, Yale University; Energy Economics 27 (2005) 25– 58.

11/25/2016