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TOO YOUNG TO DRIVE? THE IMPACT OF AGE AND GENERATIONAL COHORTS ON MOTORIZATION IN EUROPE

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Abstract

A linear regression analysis (α = 0.05) has been carried out in order to determine whether population age had any influence on motorization in Europe. Analysis results indicate that age has got a direct and positive, yet moderate effect on motorization (Multiple R = 0.0445). As age can explain up to one fifth of motorization (R2 = 0.20), the Findings and Discussions section tries to present the particular types of impact that age can have, as well as to shortlist some of the potential variables that might account for the rest of 80%. Another goal of the research was to find out what generation was most likely to influence motorization. Findingds reveal that early Millennials and late Gen X-ers can be accountable for most of the current motorization in Europe.

Keywords: motorization; urbanization; transportation; generational cohorts; demographics.

1. INTRODUCTION

Researches on urban development and transportation options constitute an important segment of urban management studies (Androniceanu, 2016; D'Souza, 2014; Narayanaswami, 2017; Pina & Torres, 2001). Transportation is a key requirement for setting up economic evolution in urban areas (Camagni et al., 2016; Masoumi, 2014; Weiner, 2016). Motorization, a sign of both economic prosperity and urbanization, is among the transportation variables receiving particular attention in academia and on governmental agendas as well (Acharya, 2005). The European Comission defines motorization as the rate of passenger vehicles, excluding motorcycles, per one thousand inhabitants, and considers it an important indicator of sustainable development (Eurostat, 2016). While, indeed, motorization triggers the progress of urban societies (Nijkamp & Rienstra, 1995), urbanization and economic growth also lead to higher travel demands and an escalation of motorization rates (Feng & Sun, 2013; Olszewski, 2007), that can result in externalities such as pollution, carbon dioxide emmissions, noise, death and injuries sustained by accidents, or traffic congestions leading to time lost in travel and delays on other forms of transportation, including public transportation (Button, 1990; Calthrop & Proost, 1998; De Borger & Wouters, 1998; Jain & Tiwari, 2016; Kraus, 1991; Newbery, 1998; Schafer & Victor, 1999; Talbi, 2017;

Wang et al., 2017). Motorized transport, thus, has evolved into a worldwide challenge that spans over economical, societal and cultural issues (Jakob et al., 2006).

The purpose of this research is to determine whether population age has got any influence upon motorization. Europe has been selected as a sampling territory for the study. While finding out the effects of age on motorization is the primary goal, the research also brings generational cohorts into discussion. The objectives of the study become two-fold, with the secondary goal being to investigate how age generations impact onto the same dependent variable. As there are two objectives, the paper also operates with two research questions.

The paper is organizaed in five sections. The Literature Review starts with a brief presentation of the generations that are currently shaping the worldwide economy (Baby Boomers, Gen X, Millennials, Gen Z), then moves on to an overview of their motorization habits. The Methodology presents the research design (data sampling, choice of variables, form of research, number of observations), the two research questions, the Null Hypothesis and the statistical analyses in order to test H0 as well as to serve the research goals (one-way ANOVA single factor analysis; t-Test: Two-Sample Assuming Unequal Variances; regression analysis). The Results section displays the raw findings of the analyses. A scatterplot graph is also presented for testing the correlation between variables. The Findings and Discussions section critically analyses the findings of the study by correlating them with previous findings in academic research. Last but not least, the Conclusions sum up the paper and provide directions for future research.

2. LITERATURE REVIEW

Generational differences constitute a prevalent topic of research in business (Jorgensen, 2003). Findings show that generational values differ among each other (Wey Smola & Sutton, 2002). Work, leisure or consumption values or attitudes change as generations do (Cennamo & Gardner, 2008; Jackson et al., 2011; Twenge, 2010). The past century has witnessed four major generations that have left their mark on society: the Baby Boomers, the Gen X-ers, the Millennials and the Gen Z-ers.

A generation is constituted by a group of people who have all been born within a specified set of years (Kupperschmidt, 1998). Apart from birth dates, members of a generation also share distinctive values and attitudes (Parry & Urwin, 2011; Schewe & Meredith, 2004). The Baby Boomers form the generation of people born between 1943 and 1960 (Giancola, 2006). They have grown up in the early post-war years, characterized through a solid economy based on industrialization and existence of jobs, meant at recovering from after-war traumas and at reconstruction (Gilleard & Higgs, 2008; Todd & Young, 2012).

The availability of jobs and the existence of a guaranteed and high income, associated with the manufacture of industrial goods, expedited the development of a consumption economy, characterized by the purchase and use of household products and appliances (Bix, 2002; Weiner, 1995; Whiteley, 1987). Baby Boomers represented a patriarchal generation, with men being the main earners of money in the household (Maugans, 1994; Podnieks, 2016). Such cultural and economic values made the car become one of the most admired products of the 1950's (Taylor, 2014, 2016). The car manufacturing industry boomed thanks to the transfer of technological developments from warfare, to an adoption of mass production in Europe and to the availability of consumer income (Liou, 1998). The Baby Boomers have shaped many parts of the world during the past seventy years (Dobbs, 2008), including setting a pattern for owing a car – a product to be used for increasing mobility. Baby Boomers have played an important role in shaping the idea of motorization. As Kostyniuk and Kitamura (1987) find out, motorization is influenced by how generational cohorts understand its benefits and hindrandces. For Baby Boomers, motorization has represented a benefit, a mindset that has been transferred to the Generation X (born between 1961 and 1981).

Generation X was characterized by families in which the income was earned by both members, thus even higher budgets available to be spent on transport goods. The father was not any longer the dominant, authoritative head of the family, but responsibilities and rights were met halfway. As more jobs were occupied by women, the mother was not so often at home as she used to be within the baby boomer generation (Erickson, 2010; Mitchell, 2001). Kids returning home from school often found the house empty, which shaped a sense of independence in them (Johnson & Johnson, 2010: 70). Years later, this 'latchkey' independence was translated through a need of mobility (Kusz, 2007: 40). The answer to these needs was owing a car in order to increase mobility. Next in line were the Millennials, born between 1982 and 1995, dubbed as The Next Great Generation after the Boomers (Howe & Strauss, 2000). Findings by Newbold and Scott (2018) reveal that Millennials are characterized by a varied set of transportation styles, which is also transferred to the Gen Z-ers (1995 – present).

3. METHODOLOGY

Taking into account that different motorizational habits have been identified between younger (Millennials, Gen Z-ers) and elder generations (Baby Boomers, Gen X-ers), this research aims to find out if population age has got any influence on motorization. The objectives of the study are two-fold. First, the research wants to establish whether a connection exists between age and motorization, and, in case yes, to investigate what are its strength and direction. Second, also assuming there is a

connection between the variables, the research wants to investigate how generations influence motorization.

Data sampling and Research Questions: The data sample used is based on statistical evidence gathered from Eurostat. Two sets of data have been collected: the variable expressing motorization rate is 'Cars per 1000 inhabitants', while the variable expressing age is 'Median age of population'. Both variables are particularized per European country. The research purpose is to analyze this statistical data for fulfilling the research objectives and for answering the research questions. As two objectives have been set for this study, there are also two Research Questions, namely:

RQ1: Does age affect motorization or not?

RQ2: What is the generation (age interval) most likely to impact motorization rates?

Research design: To establish whether the connection between age and motorization was true or false, Cars per 1000 inhabitans was chosen as the dependent variable (y) and Median age of population as the independent variable (x). A desk research has been carried out with secondary data from Eurostat. The study took a longitudinal form, with data being collected for the interval 2007-2015 (t = 9 years), for 29 European countries (Belgium, Bulgaria, Czech Republic, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Romania, Slovenia, Slovakia, Finland, Sweden, Liechtenstein, Norway, Switzerland and Turkey). The depth of the study was set at an observational period of nine years in order to avoid short-term agents exert control over study results. x and y variables were collected for the 29 countries and put head to head. A total of 261 entries resulted (9 observations for each of the 29 countries). Six entries had to be removed from the research due to unavailable motorization data: Bulgaria (year 2015), Germany (2007), France (2008), Italy (2015), Netherlands (2014, 2015), which resulted in 255 valid observations remaining available for the study (n = 255). Several countries, such as the United Kingdom or Portugal, were completely removed from the study due to a higher amount of incomplete data spreading over more than two years.

Null Hypothesis: The Null Hypothesis (H0) claims that the median age of population (x) has got no influence on motorization (y).

Statistical analyses: A one-way ANOVA single factor analysis, as well as a t-Test: Two-Sample Assuming Unequal Variances were conducted at an alpha value of α = 0.05 in order to test H0. A regression analysis (n = 255 observations; p<0.05) was run in order to check the correlation between the motorization rate of a country and the median age of that country's inhabitants.

4. RESEARCH RESULTS

The Null Hypothesis (H0) is invalidated by both the ANOVA test and the t-Test. The results of the ANOVA one-way single factor analysis are presented in Figure 1. H0 is rejected by the P-value, which is lower than the critical alpha value (0.00<0.05), and by the F-Value (2740.758), which is higher than the F-Crit value (3.859).

SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
Cars per 1000 inhabitans	255	118240	463.6863	16692.21		
Median Age	255	10201.5	40.00588	8.934887		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	22886897	1	22886897	2740.758	0.00	3.859829
Within Groups	4242090	508	8350.572			
Total	27128987	509				

FIGURE 1 - RESULTS OF THE ANOVA ONE-WAY SINGLE FACTOR ANALYSIS.
Source: own computations in Microsoft Excel based on statistical data inputs collected from Eurostat.

The findigs are confirmed by the results of the t-Test: Two-Sample Assuming Unequal Variances, presented in Figure 2, the higher value of t stat (52.35) as compared to t critical Two-tail certifying this (1.96).

	Cars per 1000 inhabitans	*Median Age*
Mean	463.686275	40.00588
Variance	16692.2083	8.934887
Observations	255	255
Hypothesized Mean Difference	0	
df	254	
t Stat	52.3522506	
P(T<=t) one-tail	2.153E-138	
t Critical one-tail	1.65087479	
P(T<=t) two-tail	4.306E-138	
t Critical two-tail	1.96934754	

FIGURE 2 - RESULTS OF THE T-TEST: TWO-SAMPLE ASSUMING UNEQUAL VARIANCES.
Source: own computations in Microsoft Excel based on statistical data inputs collected from Eurostat.

The regression analysis was conducted in order to establish the correlation value between the variables. The statistical legitimacy of the regression analysis is confirmed by the Sig-F rate of the Regression ANOVA, which lies beneath the critical α value of 0.05 (Figure 3).

Further inputs reveal that a moderate positive correlation exists between the variables (Multiple R = 0.455), a fact graphically back up by the scatterplot in Figure 4 (median age of the population is placed in the y axis, while the number of cars per 1000 inhabitants on the x axis), in which the trendline is on a

rising path: as the average value of the median age increases, the trendline follows with a right shift. This suggests the existence of a positive relationship between the variables, yet the dots in the scatterplot only account for medium effects.

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	881062	881062	66.366	0.0000000000001725900240743270
Residual	253	3358759	13276		
Total	254	4239821			

FIGURE 3 - ANOVA RESULTS FOR REGRESSION ANALYSIS.
Source: own computations in Microsoft Excel based on statistical data inputs collected from Eurostat.
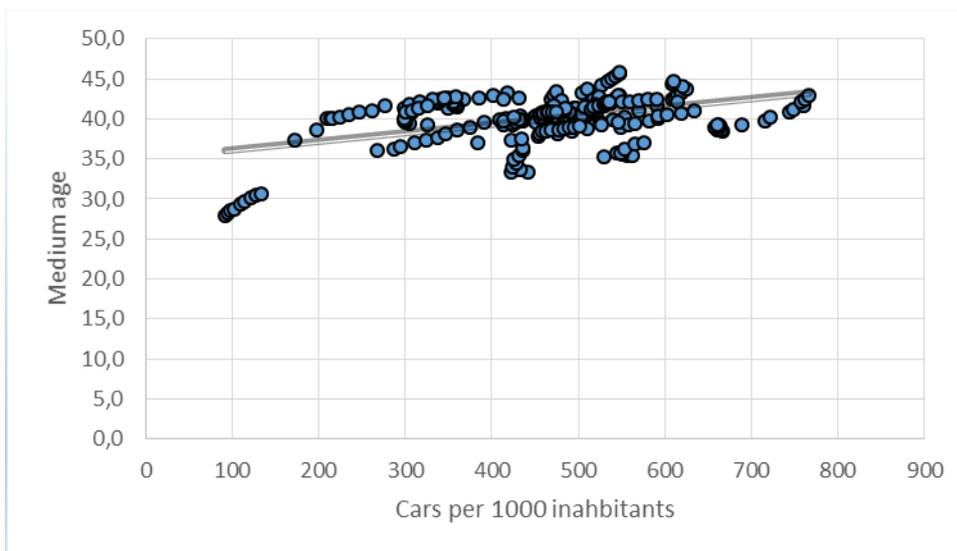

FIGURE 4 - SCATTERPLOT DISPLAY FOR CORRELATION ANALYSIS. SOURCE: OWN COMPUTATIONS IN MICROSOFT EXCEL BASED ON STATISTICAL DATA INPUTS COLLECTED FROM EUROSTAT.

The intercept value of the regression (-324.56) is meaningless for this study, as it only shows that in the case that the median age of the population was 0 (a fact impossible), then the motorization rate would be negative (at 324 cars less per 1000 inhabitants).

5. FINDINGS AND DISCUSSIONS

The results of the statistical analyses help provide an answer to the research question, namely that median age affects motorization, yet only with limited power. The R Square value of the regression (0.20) shows that one fifth of the motorization rate can be explained by population age. The rest of eighty percent able to predict motorization in a society belong to factors of influence other than age. Age can be a predictor of how many cars people buy, though not at an exhaustive level. By invalidating the Null Hypothesis, research results reveal that there is indeed a certain relationship of influence between the two factors – after all, car ownership hinges upon age: it is rather unlikely that a teenager up to 18

years owns a car (not only due to the scant available income, but mostly due to the impossibility of having a driving license before full age, which makes little meaning in owing a car without being able to drive it), while the more people advance in age and overcome a certain psycho-physical barrier, the likelier it is for them to become vehicle owners. However, many other factors beyond age have to be taken into account in order to explain motorization. These might include, amongst others, available income, paved road length (speed of infrastructure expansion), urban congestion, length to be travelled in customary activities (i.e. movement between home and work office), overcrowding, availability of public or alternative transport services, number of people killed in road accidents etc.

In what concerns the answer to the second research question, the trendline in the scatterplot (Figure 4) indicates a majority of cars being owned at an average age of 35-45, hence by late Gen X-ers and early Millennials. This finding is backed up by a study of Frändberg and Vilhelmson (2011), who identify that the elder segment of the Millennial generation might well build up to motorization rates in their respective European countries. After a comprehensive observation of transport habits in Sweden, spanning along the 1978-2006 period, the authors conclude that car driving was the prevalent mode of travel for early Millennials. The impact of Baby Boomers on motorization in Europe is reduced due to their advanced ages (many giving up driving) and to their reducing numbers. The Gen X-ers have been characterized by a need of mobility, which they have also induced into the forthcoming generation of Millennials. The early Millennials, those born by 1985, have taken up mobility and trasportation habits of Gen X-ers, which expains why the most impact on motorization is held by people aged 35-45. Yet generations often do not relate any longer to their antecessors, which leads to a shift in values (Leiter et al., 2009): people born after 1985, thus younger Millennials (late Millennials) and Gen Z-ers seem to approach transportation and motorization elsewise, being more inclined to use sustainable transport services than older generations (Delbosc & Nakanishi, 2017). Studies have revealed that, in spite of increasing motorization in industrialized countries over the past decades, late Millennials and Generation Z-ers seem to be more environmentally aware and less likely to own a car than early Millennials, Gen X-ers or Baby Boomers (Klein & Smart, 2017). Kuhnimhof et al. (2011) find out that late Millennials and Gen Z-ers have got other mobility habits than their parents, reducing automobile travel and prefering a multimodal transportation behavior. Less car-focusing and increased multimodality with biking and walking is also documented by Dutzik et al. (2014), Tiwari et al. (2016) and Zhong and Lee (2017). According to Delbosc (2017), Millennials form a complacent generation, preferring to live in neighbourhoods within reach of distance to their workplace, thus reducing from start the needs of vehicle ownership. As a matter of fact, studies report that Millennials are less likely to drive and to hold a driver's license then Gen X-ers and Baby Boomers (Delbosc & Nakanishi, 2017; Newbold & Scott,

2017) and that, if they need to travel over longer distances, they would rather choose public transit or non-motorized means of transport (Newbold & Scott, 2018). These insights explain why the Scatterplot in Figure 4 reveals that people under 35 years of age are less likelier to have a significant impact on motorization, as compared to those between 35 and 45. The younger generations (people under 35 years) change the way how people relate to motorization, giving up on vehicle property even if having grown up accustomed to cars as indispensable assets of their families. An increased awareness of car-ownership externalities, but also a reduced purchasing power and a higher environmental friendliness (Furlow & Knott, 2009; Smith, 2010) determine late Millennials and Gen Z-ers to opt for sustainable means of urban transportation to the detriment of individual cars (Kenworthy, 2006).

Setting apart generational arguments, another important idea to be taken up for discussing the findings of this research is what Dargay and Vythoulkas (1999) have called the "life-cycle" effect: property of private vehicles raises around the head of the family until he reaches about 50 years of age, then decreases. This pattern can be explained not merely by age, but by life-cycle events which create a need of owing a vehicle. 35-45/50 is a propitious age interval for owing a car because certain events intervene in peoples lives, such as the birth of children, moving out from the paternal house, changing numbers of family members, an establishment on the labor market that guarantees a certain good level income (Prillwitz, 2006). Going past teenage years and settling into a new phase of life requires more and thorough decision-making, which also includes choices pertaining to housing and motorization.

6. CONCLUSIONS AND FUTURE RESEARCH

The findings of this research have indicated that age had an impact on motorization, yet only moderate, and that the younger end of the Millennials (born after the mid 1980's) had got a milder influence on motorization than the elder counterparts, which can be related to a more environmentally-friendly awareness of younger generations, observed by several authors (Dutzik et al., 2014; Tiwari et al., 2016, Furlow & Knott, 2009; Smith, 2010). Although still likely to maintain its dominant position, the use of cars seems to receive increasing competition from alternative transportation means.

The R^2 value has shown that age can be but one of many factors likely to influence motorization. The statistical model used was limited to only one independent variable, thus narrowing the observational values. Future research should take into account a multiple regression analysis, with more than one independent variable being considered. This research has largely neglected the importance of economic, social, juridical or medical aspects. A further model is required to look at factors beyond age, such as length of roads and highways, alternative transport services, environmental policies, available

income etc. Furthermore, another limitation of this current research is that it regards generations from a purely quantitative point of view, considering them to be cohorts spanning between certain years of birth. Nevertheless, generational studies should also have a qualitative orientation to study behavioral types in connection to motorization, which this research did not, as it was restricted to a quantitative-interpretative observation of age effects.

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