FACTORS INFLUENCING HYBRID CAR OWNERSHIP IN ISLAMABAD: DOES ENVIRONMENTAL IMPACT PLAY A ROLE IN THE PURCHASE OF A HYBRID CAR?

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CERTIFICATE

This is to certify that this thesis entitled: **"Factors Influencing Hybrid Car Ownership in Islamabad: Does Environmental Impact Play A Role in the Purchase of A Hybrid Car?** submitted by Arsalan Khalid Channa is accepted in its present form by the Department of Environmental Economics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in **Master of Philosophy in Environmental Economics**.

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Abstract

Vehicle ownership has now become a fundamental part of a person's asset ownership. Today hybrid cars present an alternate, environmentally friendly way to privately commute while saving the environment. Despite the newness of hybrid technology and its projection as environmentally friendly – the factors resulting in hybrid car ownership are myriad. This study in two parts aims to investigate 1. the influencing factors which determine the intentions of people living in Islamabad to own a hybrid car in future, 2. The environmental benefits accrued from purchasing a hybrid car in monetary terms such as reduction in carbon dioxide emissions and economic benefits such as reduction in fuel prices compared to a non-hybrid car. Using the binary logit model, the perception in terms of social image, ownership, price, environmental concern and seeking environmental knowledge were analyzed. The results indicated mixed responses wherein people did show interest in buying a hybrid car but without exhibiting any pro-environment concern. Thus, environmental concern does not play a primary role in determining purchase intentions to buy a hybrid car. The environmental economic comparison of the hybrid car with its non-hybrid conventional counterpart showed that the environmental benefits accrued from using the hybrid car in terms of emissions reduction and lessened fuel costs do not completely compensate for the high price of the hybrid car in Pakistan.

Chapter 1: INTRODUCTION

Rapid technological advancements in every aspect of human life have given way to rise in demand and adoption of newer gadgets that have become an essentiality rather than a luxury. Like in every sector of local, national, regional and global economy, the automotive industry has witnessed a boom. This boom has not only intensified technological improvements and enhancement of wellbeing, but it also has led to realization of many humane aspects of nature that were earlier largely ignored. With the passing of the industrial revolution transitioning to postindustrial stage and later into the era of mass consumption, human craving for luxury has surpassed many conventionally thought boundaries. Though wellbeing may have improved with availability of many modern gadgets making life easy…all this serenity has come at a price. The price is paid in the form of environmental degradation. But one thing that is of contentment is this phenomenon's realization by the global community. Likewise, in every aspect of economic development, the automotive industry has taken a green turn now introducing green vehicles which have been well received.

The introduction of hybrid and electrical vehicles have ushered the automotive industry into what is now being termed as the "Electric Revolution". Despite constituting only 1 percent of global car sales (Bloomberg LP, 2017), the Hybrid Electric Vehicles are fast gaining recognition and recognition as the vehicles of the future. Global car giants such as Honda, Toyota, Volvo, Tesla have invested and developed many popular hybrid electric cars – most popular being the Toyota Prius that has been the most popular hybrid car globally. Volvo, one of the global car giants has claimed to shift all its manufacturing to hybrid from 2019. Now, there are claims that electric vehicles will constitute 15 percent of global car sales by 2030 causing the fuel demand to go down.

It is estimated that 22 percent of greenhouse gases are emitted by the transportation sector globally which are likely to rise by 1.75 times as we reach 2035 (Goldman Sachs, 2018). The need for hybrid electric cars that are: green, convenient, safe and affordable puts all global car manufacturers in a competition where increased technological sophistication coupled with decreasing costs of raw materials will ultimately drive higher demand. In case of Pakistan, the automotive industry has seen a remarkable growth with sale reaching to almost 1.6 million with as many as 12 local manufacturers in seen in play (Aazim, 2017). Along with other sources, role of banks in car financing has played a significant part in causing this boom, as 11.1 billion rupees

were lent in lieu of car financing (Aazim, 2017). Hybrid electric cars are imported amounting to 5000 while competing with their conventional counterparts at home. The government has imposed a 50 percent tax on import of hybrid cars that needs to be reduced to zero if heavy reliance on fuel cars is to be eliminated (Dawn, 2016).

All this is necessary as pollution statistics for Pakistan present a grim picture. An estimated 47.2 percent of petroleum products are in demand due to large extension of road networks in the county. As result an average vehicle in Pakistan emits 25 time more CO2 than an average vehicle in the United States. Here is pertinent to note that human behavior plays a critical role in determining the economic and environmental outlook of the society. The extent of environmental behavior and concern that one develops argued in many studies is largely determined by personal norms rather than inductive behavior. Pro-environmental behavior has now become a key concern in the globalized world, but its overt expression and representation requires sensitization. Emissions globally of CO2 have become a justification for developing environmentally friendly technologies of which hybrid cars are one manifest.

As a result, this study will analyze what factors influence the person's perceptions about owing a hybrid car in Islamabad city. The focus will be on understanding if environmental concern plays a significant role in forming choice for purchasing a hybrid car. Furthermore, to see if the use of hybrid car is feasible and sustainable in the context of usage in Pakistan – a comparison of a Toyota Prius Hybrid with its conventional Internal Combustible Engine counterpart Toyota Corolla was done.

1.1. Problem Statement:

The study will try to analyze and present the perceptions of the people regrading hybrid car technology and the factors influencing their choice to own a hybrid car. As hybrid car phenomenon is relatively new in Pakistan, it would be worthwhile to see what factors would influence people to either opt for hybrid car or go for a conventional car, and if environmental concern is a primary factor in determining the hybrid purchase intentions. Consequently, it would be interesting to see if hybrid cars do provide environmental benefits in terms of emissions reduction in the context of usage in Pakistan. Thus, vehicular comparison of a conventional fuel car with a hybrid car will help in examining the benefits accrued from hybrid cars.

1.2. Research Questions:

1. Does environmental knowledge and concern play a significant role in forming purchase intentions for a hybrid car?
2. Is use of a hybrid car environmentally feasible and better compared to its conventional counterpart in the case of Pakistan?

1.3. Objectives of the study:

1. To investigate the factors influencing peoples' perception about purchasing a hybrid car
2. To investigate if environmental concern is a major contributing factor in peoples' intentions to purchase a hybrid vehicle
3. Conduct a comparison between a conventional Toyota Corolla and a Toyota Prius Hybrid car with emphasis on purchasing cost, fuel efficiency and reduction in CO2 emissions in the case of car usage in Islamabad.

1.4. Significance of the Study:

The study is redounding to the benefit of other researchers and policy makers interested in understanding the impacts of hybrid cars usage in the country. The study's attempt to compare the socio-economic and environmental costs of a hybrid car and its conventional counterpart will highlight the benefits and disadvantages of owing a hybrid car in Pakistan. It will not only help in understanding the social, economic, cultural and personal factors influencing the purchase intentions of hybrid car but will also elaborate on how much environmental knowledge and concern play a significant role in determining the purchase. The findings of this study will help policy makers and researchers to formulate strategies and policies regarding promotion of hybrid cars in the country, as increasing population and desire to own a private car will increasingly drive demand for private passenger cars.

Chapter 2: LITERATURE REVIEW

As rapid urbanization and a growing population (Ahmadani, 2017) present a manifestation of national growth and human resource, yet these phenomena pose a challenge for the state and common man alike. Likewise, everyone who can afford a car would like to own one instead of preferring a public transport mode, even if it is better, because it leads to compromise on privacy and leisure (Steg, 2003); (Jaffe, 2013). At this notion, it becomes pertinent to address the environmental dimension of the increase in ownership of private vehicles.

2.1.Booming automotive industry in Pakistan:

Nowadays, it is easily observable in daily routine as one travels either by any mode or simply on foot that shiny new cars and old, belonging to different class types: compact, sedans, SUVs and many more traveling on the road. Generally, one may think that it is due to betterment in financial status and a growing economic setup that gives way to purchase and ownership of cars. Technological breakthroughs resulting in increased convenience have now penetrated the transport sectors in from of fast and comfortable cab services such as Uber and Careem. This has led to a tremendous rise in demand for vehicles either produced locally or imported from abroad. In 2016-17 alone. 185,781 car units were sold outdoing 2015-16 record of 181,145 (Hamza, 2017). Role of banks has played an influencing part in this boom. In July-September of 2017, the banks loaned Rs. 11.1 billion in car financing (Aazim, 2017). This corroborates to a 60 percent increase in the automotive sales just in July-September period of 2017 compared to same period in 2016 (PAMA, 2017).

Not only sale of locally manufactured cars has soared, imports of cars have seen a considerable rise, as in 2015, 41,257 units were imported containing 5000 units of hybrids competing with Honda and Toyota brands used at home (Abduhu, 2016). As same approximately 65000-7000 vehicles were imported in FY 2017 with 1.4 to 1.6 million sales made domestically with as many as 12 players manufacturing domestically (Business Recorder, 2017). As hybrids have found a market in Pakistan, the government has imposed a 50 percent duty rebate on hybrid purchases

which according to experts should be made zero percent for it eliminated the need to rely heavily on oil fueled vehicles (Dawn, 2016).

The country is sought after by many international car manufacturing companies such as Renault, Hyundai, Nissan, Tesla, Honda, Toyota and Volkswagen, who are manufacturing hybrid models which can find a demanding market. Especially car giants such as Renault and Hyundai have shown keen interest in entering the Pakistani automobile market (Ahmed, 2017). The demand may go up as installation of public battery charging installations such as one installed in Lahore by the BMW group will lead to increased inclination to buy a hybrid vehicle (The Express Tribune, 2017).

2.2. Air Pollution and Vehicular Emissions:

Vehicle emissions make up a significant part of air pollution along with industrial emissions (Rahbar, White, Agboatwalla, Hozhabri, & Luby, 2002). Growth in vehicle population and kilometers driven in conjunction put a hazardous impact on air quality in Pakistan. Extensive network of roads in the country results in high demand of petroleum products standing at 47.2 percent of total petroleum products produced and imports; also ageing vehicles constitute for about 50 percent of total fleet leading to incomplete combustion resultantly adding more hazardous emissions to the atmosphere (Khwaja & Khan, 2005). An average Pakistani vehicle emits 25 times more CO_2 and 20 times more nonmethane hydrocarbons and 3.5 times more Sulphur dioxide than vehicles in the United States (Dawn, 2004); (Barber, 2008). In the capital Islamabad, the concentration of CO_2, NO and SO_2 and $PM_{2.5}$ have surpassed the levels set by Pakistan National Environmental Quality Standards (NEQS) (Rasheed, Aneja, Aiyyer, & Rafique, 2014). Along with air pollution, noise pollution comes in as another externality that not only impacts health of commuters but also indirectly on the residents (Mayeres, Ochelen, & Proost, 1996); (Ochelen, Proost, & Dender, 1998); (Lakshmanan, Nijkamp, Rietveld, & Verhoef, 2001); (Hyder, Ghaffar, Sugerman, Masood, & Ali, 2006); (Evans, 2007); (Ortugar, 2007); (Shabbir & Ahmed , 2010).

2.3. Perceptions, Attitudes and Environmental Concern:

Environmental concern now forms another aspect when performing any economic activity. Say it be mega projects or any simple activity, environment comes in as an opportunity cost. Car emissions are a critical issue faced worldwide. In developed countries there are penalties and

incentives that are directed towards minimization of private car use with the intent to cap emissions and shift towards public transport (Verhoef, Nijkamp, & Rietveld, 1996); (Greene & Wegener, 1997); (Button & Nijkamp, 1997); (Mayeres I. , 2000); (Lakshmanan, Nijkamp, Rietveld, & Verhoef, 2001); (Evans, 2007).

Human nature is a complex study. In recent decades, environmental concern and pro-environmental movements have surged. But at the helm of all these movements and aspirations to save environment lies the basic nature of human being. People's attitudes, perceptions and intentions are greatly influenced and molded by social, cultural, economic and personal norms and behaviors which lead to a mass effect. Minton and Rose (1997) conducted a study that involved seeing impact of environmental concern, personal norms and inductive norms on behavior and behavioral intentions hence concluding that personal norms played primary role in shaping environmental behavior rather than inductive behavior. Though personal norms form an influencing factor in determining environmentally friendly behavior but as argued by Gatersleben et al (2002) pro-environmental behavior is not directly related to pro-environmental attitude and actions. Pro-environmental behavior indirectly influences household attitudes. Adding to this notion Bamberg (2003) and Barr (2004) argue that situation specific cognitions are direct determinants of behavior as environmental concern is not direct but an indirect determinant of specific behavior. Mierlo et al (2006) examining the provisions and recommendations of European research programme state that hybrids are modern sustainability solutions and should be improved upon keeping in view long term socio-economic development.

Today, curbing emissions is a global goal and one way to realize this curb in short term is through use of hybrid vehicles (Prud'homme, 2010). Adopting these vehicles is a critical issue. Though in developed economics such as US, Europe and China, there has been a remarkable increase in demand for hybrid and electric cars and globally there is a surge in demand for these cars (Vaughan, 2017). Associated with this demand is a set of influencing factors that determine the perception of a person's inclination towards purchasing a hybrid vehicle. Social, cultural, self-image and peer pressure, fuel costs and environmental concern and knowledge form few critical factors who shape and mold perception towards opting a hybrid over a conventional vehicle (Heffner, Kurani, & Turrentine, 2005); (Turrentine, Delucchi, Heffner, & Sun, 2006); (Hawkins & Gausen, 2012).

Anable (2005) using the theory of planned behavior analyzed the factors determining human behavior. Identifying distinct groups based on theoretical setup, the study concluded that there were aspiring environmentalists who reduced car usage for sake of environmental concern; those who did not own a car were identified as car-less crusaders had sacrificed car ownership for environmental reasons; then there were car addicts who associated their self-image and leisure with car use even though there was availability of modal shift. Furthermore, education plays are critical role as aspiring environmentalist were mostly educated people having sound knowledge of environmental problem while complacent car addicts were the least educated in such matter. In conjunction, same conclusions were obtained by Zareie and Navimipour (2016) which stated that environmental knowledge obtained through electronic sources has a direct effect on person's environmental behavior.

As environmental concern has led to a shift in the purchasing criteria of the consumers. Though environmental concern may define changed perceptions, it necessarily does not entail adoption of green products (Hessami, Yousefi, & Goudarzi, 2013). Energy saving behavior is more related to gender difference and employment status as economic factors put strain on utilization of resources (Pothitou, Hanna, & Chalvatzis, 2016). High fuel costs and reduction in battery costs will lead to increased adoption of hybrid cars (Simpson, 2006); (Hawkins, Gausen, & Stromman, 2012); (Babaee, Nagpure, & DeCarolis, 2014). People's perception is a fundamental indicator for successful penetration of hybrids in consumer markets. Adopting hybrids as green solution was earlier thought of as a sour dream as only a high rise in oil prices or price regulation only would lead to mass adoption of hybrids (Lave & Maclean, 2002). Heffner et. al (2005) identify that people associate purchase of hybrids with intelligent consumerism and social responsibility, concern for others and larger values, while considering use of conventional large SUVS as negative conveying message of selfish egoist behavior. People tended to symbolize a pro-environmental behavior by using hybrid cars. Through fuel saving and other accrued benefits people perceived themselves to be projecting an environmentalist behavior, showing concern for the environment. In turn, they connected these actions to a broader set of social values encompassing environmental stewardship.

Granovski et al (2006) conducting a scientific analysis of technological makeup of the hybrid and conventional cars conclude that hybrid cars are more environmental friendly (Zivin, Kotchen,

& Mansur, 2012); (Ma, Balthasar, Tait, Riera-Palou, & Harrison, 2012); (Gustafsson & Johansson, 2015); (Archsmith, Kendall, & Rapson, 2015) compared to conventional vehicles that will lead to increased favorability for use of hybrid cars. Even though hybrids have - due to better technology and attributes - weakened the demand for conventional vehicles, complete shift to hybrids will take a long time in the US as increased competition from conventional car makers will witness improvement in technology. Flam (2007) concludes that pro-environmental behavior is associated with less kilometers driven, possession of hybrid cars and concern for other. In contrast, Oliver and Lee (2010) comparing responses from South Korean and US drivers presented interesting results. US drivers were not in favor of hybrids while Korean users preferred hybrids. This due to cultural differences of the two countries, one being a collectivist mindset while the other being individualistic.

Preferring a hybrid car as a green transport mode is not primarily determined by environmental concern. As shown in the study conducted by Potoglu and Kanaroglou (2007) concluded that people preferred hybrid cars when there was an accompanying incentive of less payment of taxes, less fuel expenses and greater environmental concern. Though there was more stress on economic factors such as reduced fuel expenses and less payment of taxes, environment concern came in a complementary advantage. Knowledge about environment and hybrid technology is another determinant that influences inclination towards use of hybrids. Egbue and Long (2012) conducted a study analyzing responses from technology enthusiasts who had knowledge of the technological makeup of hybrid and conventional vehicles. The conclusion was that if technological knowledge is present, then there would be a widespread adoption of hybrids as people - with no or less knowledge - are hesitant in adopting hybrids. In addition, Al-Alawi and Bradley (2013) did a total cost ownership analysis of hybrid vehicles identifying lower net cost of ownership resulting in shorter payback period leading to higher consumer preference.

Nanaki and Koroneos (2013) compared the environmental benefits of use of hybrid and conventional cars. For hybrid cars greenhouse gas emissions were 6.85 percent against 55.2 percent of conventional vehicles; and 5.76 percent of total air pollution compared to 61.4 percent emanating from conventional car use – suggesting that use of hybrids was not only beneficial in economic terms but also it was environmentally friendly. Holland et al. (2016) conducted a comparison of air pollution reduction by use of hybrid cars and conventional cars, stating that use

of hybrids led to significant reduction in emissions which remain constant even though income may rise; on the contrary emissions from conventional cars increase as income increases.

With this view, this study undertakes the objective of investigating the perception of people living in Islamabad over possession of a hybrid car. The study will explore and scrutinize the social, cultural, personal and economic factors governing such perceptions. Furthermore, as proved by Al-Alawi and Bradley (2013) that owning a hybrid car is more cost efficient than a conventional car; this study will do the same by comparing popular car brands i.e. Toyota Prius Hybrid with its conventional counterpart Toyota Corolla with the intent to examine reduction in fuel costs and reduction in emissions in the case of usage in Pakistan.

Chapter 3: Methodology

3.1. Study Area:

The study area for this research is Islamabad Capital City. The target population is the people possessing at least one car for private travel mode. The car owned can be either hybrid or non-hybrid car. This is because there are approximately 0.7 million registered cars in Islamabad with monthly 6000 cars being registered per month. Every day 90 to 100 private cars are being registered in Islamabad (Federal Excise and Taxation Office, 2016). As a result, the study focusing residents of Islamabad will provide important insights into the factors influencing peoples' perceptions about owning a hybrid car.

3.2. Sample Size and technique:

The sample taken for the study is 145 respondents. The respondents need to own a car: either a hybrid or a non-hybrid - who will be asked about their preference when they intend to change their car. The sample of 145 respondents is taken due to unavailability of data regarding the total number of hybrid car owners in the city. Purposive sample technique is used to obtain information about self-image, seeking environmental knowledge, social perception about owing a hybrid car, economic benefits accruing from owing a hybrid car, CO_2 emissions from vehicle usage and information about hybrid technology.

3.3. Econometric model:

i. Ownership model:

$$\boldsymbol{HybOwn} = \beta 0 + \beta 1 gend + \beta 2 Age + \beta 3 edu + \beta 4\, Inc + \beta 5\, no.carown + \beta 6\, attr + \beta 7 hybinfo + \beta 8\, ownperc + \beta 9 price + \beta 10 Envknow + \mathcal{E}$$

ii. Variable Description:

1. $gend$ = gender
2. Age= age
3. edu = education
4. Inc = income
5. $no.carown$ = number of cars owned
6. $attr$ = car attributes

7. $hybinfo$ = information about hybrid technology
8. $ownperc$ = ownership reference
9. $price$ = price of the car
10. $Envknow$ = environmental knowledge

iii. Comparison of Toyota Prius Hybrid with Toyota Corolla

The environmental economic comparison of a hybrid car: a Toyota Prius Hybrid with its conventional counterpart Toyota Corolla 1.8 2018 model was done with emphasis to investigate the differences in purchasing costs and quantified environmental benefits accrued from the usage of both cars. The unit of analysis in this regard is the carbon dioxide emissions for which the social abatement costs estimated by the environmental protection agency are used. The costs estimated are at 5 percent discount rate. Thus, the abatement costs are used for comparison and analysis.

Sr. No.	Variable's model name	Variable Description	Expected Sign
		Ownership Model	
		Dependent Variable	
1	$HybOwn$	Owning a hybrid car	
		Independent Variables	
2	$gend$	Gender	+, -
3	Age	Age	+, -
4	edu	Education	+
5	Inc	Income	+
6	$no.carown$	Number of cars owned	+, -
7	$attr$	Attributes of the car	+, -
8	$hybinfo$	Information about hybrid cars	+
9	$ownperc$	Ownership perception about the hybrid car	+, -
10	$pric$	Price of the car	-
11	$Envknow$	Environmental knowledge	+

iv. Variable Explanation

1. Gender:

The gender variable is not unambiguous given the factor of uncertainty that influences the relationship. It is because people irrespective of their gender may show preferences for a hybrid or non-hybrid car. Males or females may opt for a hybrid instead or a non-hybrid car and vice versa. As a result, gender specificity corresponding to car choice is not strictly applicable (Heffner et al, 2005).

2. Age:

The age variable has the same sense. The relationship is not unambiguous i.e. either positive or negative - as increase in age does not necessarily correspond to preference for hybrid car over the non-hybrid car. As studied by Moons and Pelsmacker (2012), older females with high education are more likely to opt for hybrid cars. In addition, Plotz et al (2014) studied the age group most likely to buy a hybrid car wherein males with technical experience in middle age group preferred to own a hybrid car.

3. Education:

The education factor is taken to be positive in relation as higher education is expected to correspond to buying a hybrid car representing increasing pro-environmental attitude (Moons & Pelsmacker, 2012), (Klockner et al, 2013), (Flamm, 2007), (Egbue & Long, Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perception, 2012), (Erdem et al, 2010).

4. Income:

Income has a positive impact. It is because increase in income results in change in preference as one can now opt for a hybrid car due to enhanced affordability (Alawi & Bradley, 2013), (Erdem et al, 2010), (Caulfield et al, 2010).

5. Number of Cars Owned:

The number of cars owned is an important variable. As studied by Flamm (2007), people with pro-environmental behavior tend to own a greater number of hybrid cars instead of non-hybrid cars. Also, hybrid cars have been kept as second option by many users (Ozaki & Sevastyanova, 2011), (Klockner et al, 2013). It is important to note that in some cases people owing to multiple reasons keep more than one car. Consequently, in one aspect the number of cars owned does implicate adoption of hybrid cars as

primary or second choice of private travelling (Erdem et al, 2010). On the contrary, keeping a hybrid car as a second option is not unambiguous.

6. Car Attributes:

Car attributes is another important determinant. It is yet not unambiguous. People may or may not find hybrid cars more attractive to buy than non-hybrid cars. Due to high costs of hybrid cars and limited battery range - to name a few most cited drawbacks; car attributes of hybrid cars are not unambiguous (Egbue & Long, 2012). On the contrary, less emissions, comfortable drive, less noise, an alternative energy source adds to positive attributes of hybrid cars (Gallagher & Muehlegger, 2008), (Erdem et al, 2010), (Plotz et al, 2014).

7. Information about Hybrid Technology:

Information about hybrid technology is positively related. From the literature, it is observed that people with reasonable amount of information about hybrid technology show interest in owning a hybrid car. Thus, the more the information one gets about hybrid technology, the more is the probability that that person will opt for a hybrid car (Plotz et al, 2014), (Moons & Pelsmacker, 2012), (Egbue & Long, 2012).

8. Ownership Perception:

Ownership perception is not unambiguous. People may not be inclined to own a hybrid car, or may be inclined to buy a hybrid car on the basis of their perception about their social status (Heffner et al , 2005), (Egbue & Long, 2012), (Ozaki & Sevastyanova, 2011).

9. Price of the Car:

Prices are negatively related to hybrid car ownership. Higher prices of hybrid cars are an obstacle in shifting towards hybrid cars (Egbue & Long, 2012), (Potoglu & Kanaroglou, 2007). As a result, the relationship is defined as negative in the literature and, also it is negative in this study.

10. Environmental Knowledge:

Being another crucial variable, environmental knowledge plays an important part in determining hybrid car ownership. From the literature, it is seen that people with higher environmental knowledge tend to show preference for owing a hybrid car. It is because environmental knowledge corresponds to amplification of pro-environmental behavior

and attitude of which owning a hybrid car is an example (Heffner et al, 2005), (Egbue & Long, 2012), (Erdem et al, 2010), (Hong et al, 2013).

Chapter 4: Data

4.1.Questionnaire:

The questionnaire (see Appendix) was designed to ask the private car owners about their perception about hybrid cars and their intention to own a hybrid car. The questionnaire was designed in May 2018 and was put to application in the same month. The time taken for completion of a single questionnaire was 10 to 15 minutes. Table 4.1 shows the structure of the questionnaire which made up the whole information set for analysis.

Table 4.1 Structure of the Questionnaire

Part	Content
1	General/Demographic Information
2	Information about car usage and costs
3	Information about Hybrid Technology
4	Information about various factors influencing hybrid car ownership

The first part of the questionnaire asked the respondents about their age, marital status, years of education attained, number of cars owned and its condition. This section only dealt with the preliminary set of information which determines the orientation of the study.

In the second part, the respondents were asked about the car they currently own and the condition of the car when they bought it. Furthermore, they were asked about how much distance they travel on average in a day and the subsequent fuel and maintenance expenditures they normally bear. As the car speed is an important indicator of the emissions emanating from the car, the respondents were asked about the average speed they maintain when driving within the city and when driving on a highway. This is important as driving speeds change drastically as normally, people tend to drive fast on highways due to less congestion and speed thrill.

The third part of the questionnaire askes the respondents about their familiarity with the hybrid car technology. As it is a new technology now rapidly making a place for itself in the automotive market, it was important to ask the respondents about their extent of

knowledge regarding the hybrid technology. Simple questions were asked from the respondents like if they were aware of the hybrid technology and if the respondents answered "yes", then they were asked about their major source of information about the hybrid car technology. In addition, they were asked to rate the quality of the information they held about hybrid car technology.

The last part of the questionnaire asked the respondents to rate their answers on a 5-point Likert scale about the factors influencing their perception about owning a hybrid car. This part included multiple factors such as social image of a person, perceived social satisfaction derived from owing a hybrid car, the environmental aspects determining a person's perceptions and attitudes to think about environmental issues and finding solution through changing personal habits such as purchasing declared environmental friendly products or inquiring if any environmental friendly products are available in the market – all these factors were made part of the questionnaire. This is done with the intent to see if hybrid car ownership is motivated by a sense of environmental concern or other factors which have no pro-environmentally concerning basis.

4.2.Data Collection

The data was collected from the residents of Islamabad. The target respondents were the private car owners who at least owned one private car for personal use. The total number of the respondents is 145 comprising of both males and female respondents although male respondents were more in number. The unit of analysis in this study is the individual car owners owning at least one private car for personal use. Time constraint and the time taken to interview a single respondent made it impossible to select a larger sample. The data was collected in the months: June and July. The respondents were selected through convenience sampling. The data collected was through face-to-face interaction so that data collected was at most reliable and not highly biased. Still it was impossible to get a perfect data for there still exists the possibility of unreliable information. This is because people hesitate to declare information related to their income and number of cars they own. They declared approximations of incomes they earn instead of declaring their exact incomes.

Certain instructions were provided to the respondents for their feedback.

1. The respondents were introduced to the topic and informed about its importance to gain and build their interest. They were requested to fill up the questionnaire while assuring them of the pledge to keep their provided information and identity confidential.
2. The respondents were asked about their age, gender, income, residence, current car owned, and the number of cars owned.
3. The respondents were further asked to rate their responses on the various aspects relating to their perception about owning a hybrid car.

4.3.Data Analysis

i. Respondent's Profile

Table 4.1 Respondent's Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
	Male	131	90.3	90.3	90.3
	Female	14	9.7	9.7	100.0
	Total	145	100.0	100.0	

The total number of respondents for the study is 145 as shown in table 4.2 – comprising dominantly of males numbering 131 constituting 90.3 percent of the total sample while female drivers numbering 14 made up the remaining 9.7 percent of the total sample. The number of males is greater compared to females as when collecting the data there were more male drivers observed on the road who were interviewed.

Table 4.3 below shows the age ranges of respondents wherein majority of the respondents lie in the age range of 26-30 and 36-40.

Table 4.2: Age Composition of Respondents

Sr. No.	Age (Years) Range	No. of Observations	Mean Age Value (Years)
1	18 – 25	17	22.53
2	26 – 30	26	28.44
3	31 – 35	20	33.30
4	36 – 40	21	38.10
5	41 – 45	16	43.31
6	46 – 50	20	47.80
7	51 – 55	16	53.44
8	56 – 60	6	57.00
9	61 – 65	2	63.00

The table 4.4 shows the occupation of the respondents. Majority of the respondents are private employees numbering 73 making up 50.3 percent of the total sample. In the second place, public employees are the highest in number numbering 39 making up 26.9 percent of the total sample while respondents owning own businesses numbering 22 make up 15.2 percent of the total sample. Whereas 11 respondents identified themselves as students constituting the remaining 7.6 percent of the sample. The ones identifying themselves as students have been taken even though they may not personally own the car but are financially supported by their families.

Table 4.3: Occupation of the Respondents

		Frequency	Percent
	Student	11	7.6
	Public Employee	39	26.9
	Private Employee	73	50.3
	Own Business	22	15.2
	Total	145	100.0

Though males dominate the sample, various occupations occupied by them as shown in table 4.5 reveal that majority of them are private employees working in private firms i.e. 64 male respondents work in private firms while 36 male respondents are public employees; 20 male respondents have own businesses while only 11 male respondents are students. Likewise, the trend is almost the same for female respondents despite being low in number: 9 female respondents are private firm employees while 3 are public employees and 2 female respondents have their own businesses. None of the female respondents identified themselves as students.

Table 4.3: Frequency of occupation of the two Genders

		Occupation				Total
		Student	Public Employee	Private Employee	Own Business	
Gender	Male	11	36	64	20	131
	Female	0	3	9	2	14
Total		11	39	73	22	145

Majority of the respondents have done master's degree as shown in table 4.6 which shows the educational status of the respondents. Those identifying themselves as Masters numbering 51 constitute 35.2 percent of the total sample only to be seconded by M.Phil. qualified numbering 47 making up 32.4 percent of the total sample. Out of the total sample, majority of the respondents lie in the bracket of either being qualified as bachelor, masters or PhD.

Table 4.4: Education Status of the Respondents

Education Level	Frequency	Percent
Intermediate	3	2.1
Bachelors	34	23.4
Masters	51	35.2
MPhil	47	32.4
PhD	10	6.9
Total	145	100.0

As hybrid cars have made inroads into the automotive markets and are gradually being purchased by many people, it is pertinent to consider the basic knowledge one may possess

about the hybrid technology. In this regard, the respondents were asked if they are aware of the term “Hybrid Technology”. Though the question posed was in a general manner without having any complementary relationship with the education level of a respondent, it is interesting to note as shown in table 4.6 that one PhD qualified respondent answered “No” to the question and 2 Masters qualified, 1 Bachelors and 1 MPhil qualified respondent also responded “No”. Only a total of 6 respondents responded “No”. On the contrary, the table further shows that majority of the respondents did respond in conformity to the question regarding familiarity with hybrid technology.

Table 4.5: Education level versus knowledge about hybrid technology

		Are you familiar with the term "hybrid technology"?		Total
		No	Yes	
Highest level of education	Intermediate	0	3	3
	Bachelors	1	33	34
	Masters	2	49	51
	MPhil	2	45	47
	PhD	1	9	10
Total		6	139	145

The incomes recorded from the respondents were in the range of Rs. 20,000 to Rs. 400,000. Table 4.7 shows the income ranges wherein most of the respondents i.e. 71 respondents lie in the income bracket of Rs. 50,001 – 100,000 with the mean income recorded as 75, 450.704. Only 4 respondent’s incomes lie in the range of 350,001 – 400,000.

Table 4.6: Income Ranges of the Respondents

Sr No.	Income Ranges	No of Observations	Income (Mean Values)
1	20,000 – 50,000	29	36,896.5
2	50,001 – 100,000	71	75,450.7
3	100,001 – 150,000	26	138,461.5
4	150,001 – 200,000	10	196,000.0
5	200,001 – 250,000	4	247,500.0

6	250,001 – 300,000	8	300,000.0
7	300,001 – 350,000	1	350,000.0
8	350,001 – 400,000	4	400,000.0

The sectors wise income levels shown in the table 4.8 show the average income of the respondents belonging to a particular sector. The sectors labelled as D, E, F etc. are denoting the various residential sectors of Islamabad to which respondents belong to. Thus, the data shown in table 9 is based on the sample data representing the income level of the sectors which shows that sectors F, G, and I have the highest number of respondents with broad income range. Sector I has the highest number of respondents recorded i.e. 68, only to be seconded by Sector G which has 43 respondents and then at the third place Sector F which has 26 resident respondents. In the high frequency sector i.e. Sectors F, G and I: Sector F has the highest mean income of rupees 127,538, and Sector G comes at the second place having mean income of 121,651 rupees and at the third place is Sector I whose mean income is 106,911 rupees.

Table 4.7: Sector wise income levels

Sr. No.	Sectors	Code assigned	No. of Observations	Minimum Income Value	Maximum Income Value	Income Mean Value
1	D	1	2	60,000	300,000	180,000
2	E	2	1	150,000	150,000	150,000
3	F	3	26	20,000	400,000	127,538
4	G	4	43	20,000	300,000	121,651
5	I	5	68	25,000	400,000	106,911
6	M	6	3	100,000	110,000	103,333
7	B	7	1	200,000	200,000	200,000
8	S	8	1	90,000	90,000	90,000

Ownership of multiple vehicles can be due to many reasons, but the most obvious reason is to keep a personal vehicle for oneself while accommodating other family members

through ownership of multiple cars. Consequently, the respondents were asked about the number of cars they own, and do they own a hybrid car. In table 4.9, majority of the respondents do not own a hybrid car despite owning up to 4 cars. Only one respondent who own 4 cars has one hybrid while those having two cars, 6 of them own one hybrid and the other a non-hybrid. A total of 124 respondents who only own 1 car comprise of 95 respondents who own non-hybrid car and 29 own hybrids. Those owing two cars making up a total of 13 respondents comprise of 7 respondents whose both cars are non-hybrids while 6 respondents own one hybrid and one non-hybrid car.

Table 4.8: Number of cars owned versus owning a hybrid car

		Do you own a hybrid car?		Total
		No	Yes	
How many cars do you own?	1	95	29	124
	2	7	6	13
	3	1	6	7
	4	0	1	1
Total		103	42	145

ii. Driving Habits

As it is well known that the environmental benefits accrued from use of a car are broadly based on the driving habits of a person. Furthermore, driving habits include the speeds at which a driver drives within the city that is on city roads and on highways. From literature and general observation, it is well known that a person tends to drive faster on highways which causes more fuel consumption and emissions. In this regard, the respondents were asked to state their average distance covered in kilometers a day, and subsequent monthly fuel and maintenance expenditures they normally bear.

It is pertinent to state here that the expenditures on fuel and maintenance have been asked from both kind of respondents: the ones who own a hybrid car and the others who own a non-hybrid car. Thus, it becomes easier to understand differences in fuel and maintenance costs of both kinds of cars.

Table 4.9: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
What is your monthly income? (Rs)	145	21000	400000	119089.6	85706.858
How many kilometers per day do you travel on average? (km)	145	20	110	47.6	19.066
NON-HYBRID CAR OWNERS					
NH_What is your average monthly fuel cost? (Rs)	103	1000	30000	12208.7	5307.008
NH_What is your average monthly maintenance cost? (Rs)	103	1000	12000	5781.5	2568.350
NH_Average speed while driving within the city? (km/h)	103	50	100	70.9	10.960
NH_Average speed while driving on highways? (km/h)	103	70	150	120.3	19.813
HYBRID CARS OWNERS					
H_What is your average monthly fuel cost? (Rs)	42	4000	12000	7785.7	1760.484
H_What is your average monthly maintenance cost? (Rs)	42	2000	8000	5154.7	1571.422
H_Average speed while driving within the city? (km/h)	42	50	80	70.9	8.208

H_Average speed while driving on highways? (km/h)	42	90	150	125.0	14.356

Table 4.10 shows the minimum and maximum levels of incomes recorded which gives an average income of Rs. 119,089.6. Income is a critical determinant in explaining the type of car owned and the way a car is used for private usage. It is shown in the table that the fuel expenditure for a non-hybrid car (NH denotes non-hybrid cars) is greater compared to a hybrid car: the fuel cost for a non-hybrid car (NH) is Rs. 12,208.7 compared to Rs. 7,785.7 for a hybrid car. This difference confirms the claim that hybrid cars are more fuel efficient than non-hybrid cars. Despite the fuel efficiency advantage of hybrid cars, the maintenance costs compared for both hybrid cars and non-hybrid cars as shown in the table 4.11. It shows that the maintenance cost of hybrid cars is roughly the same as that of non-hybrid cars i.e. Rs. 5,781.5 for a non-hybrid car against Rs. 5,154.7 for a hybrid car. It is proved in the literature that hybrid cars' maintenance is normally the same or somewhat greater than the maintenance cost of a non-hybrid car. This is due to the relative newness of the hybrid technology in the automotive market which will take time to become as cheap in maintenance and affordability as of non-hybrid cars.

Additionally, emissions are based on the activity of the engine and its maintenance. Despite the claims that hybrid cars emit no emissions at all due to their electric technology…the claim rests on observance of certain practices which validates the claim. Up to a certain speed, a normal hybrid car operates on the installed battery which provides it power, while the fuel setup charges the battery. Exceeding the speed at which the battery operates, a hybrid car shifts to normal fuel engine setup now emitting emissions. In this view, the respondents were asked to state their speed at which they drive within the city and on highways. The table shows that the average speed for non-hybrid cars and hybrid cars is roughly the same: 70.9 km/h for non-hybrids against 70.9 km/h for hybrid when driving within city and when driving on a highway – 120.3 km/h for non-hybrid car against 125.0 km/h for a hybrid car.

Chapter 5: Results and Discussion

Generally, in observation and thinking, aspects of personality such as gender, age, education and income serve as indicators of social setting - be it in observance of social mores or technological infusion in the lives of the people. Amid this general setting, there are always interesting exceptions which can be attributed to the changing dimensions of the society as it advances through time. In this study, one of the objectives was to investigate if people, when intending to buy a hybrid car take into consideration the "environmental concern" factor. Various other aspects are also taken for analysis. The second section pertains to the environmental-economic analysis of the Toyota Prius Hybrid and Toyota Corolla.

5.1. Hybrid Car Ownership Analysis:

Table 5.1 Regression Results

	B	S.E.	Wald	Sig.	Exp. (B)
Gender	-1.969	1.801	1.195	.274	.140
Age	-.031	.046	.461	.497	.969
Education	.791	.561	1.986	.159	2.206
Income	.000	.000	.841	.359	1.000
Familiarity with Hybrid Technology	3.295	2.135	2.381	.123	26.980
I feel satisfied using a hybrid car	.531	.753	.498	.481	1.701
In future I will buy a hybrid car instead of a normal car	3.601	1.095	10.817	.001	36.627
Prices are important in determining my purchase choice	.760	.808	.885	.347	2.139
I believe the prices of hybrids should be lower compared to non-hybrid cars	-.625	1.011	.382	.536	.535
If hybrids are expensive I will not buy them	.978	.712	1.888	.169	2.658
Even if hybrids are less expensive I will not buy one	.018	.554	.001	.975	1.018
I am willing to pay a higher price for a hybrid car	-.269	.543	.245	.621	.764

I think my friends and family will approve of my choice of non-hybrid car	-1.677	.716	5.480	.019	.187
I think my friends and family will not approve of my choice of owning a hybrid car	-.346	.876	.156	.693	.707
My status will affect negatively if I use a hybrid car	.593	.784	.571	.450	1.809
I am uncertain about the impacts of vehicular emissions on my daily life	.155	.648	.057	.811	1.167
Hybrid vehicles are more of a liability than being environmentally friendly	-2.257	.907	6.194	.013	.105
I usually try to find available environmentally friendly products in the market	-1.987	.897	4.905	.027	.137
I am aware of the environmental damage caused by the products I use	-1.673	.745	5.039	.025	.188
Would you recommend a hybrid car to others	1.505	.863	3.043	.081	4.503
Constant	-8.592	6.530	1.731	.188	.000

Table 5.1 shows the analysis of various factors ranging from demographic variables such as age, gender, education and income to perception-based questions with the intent to understand what factors play significant role in determining hybrid car purchase intentions and if "environmental concern" is one of these factors.

Using binary logit model to regress if a person would choose to buy a hybrid car in future instead of a non-hybrid car; factors ranging from gender and income to perceptions about ownership, car price, social image, environmental aspects and seeking environmental knowledge are analyzed. The regression table (Table 5.1) shows that the variable age and gender are insignificant. The reason for their insignificance is that it is not a hard and fast rule that gender differences primarily determine purchase choices. Buying a hybrid car is not strictly dependent on gender differences for either a male or a female can buy a hybrid car without associating the purchase with their gender identity. Moreover, age is insignificant. For it to be insignificant means

that it is not the individual itself who is solely purchasing the car, but maybe other family members may buy one and a person may use it to own benefit.

Additionally, education and income are insignificant factors. Education factor despite being positive is insignificant. This is because even having higher number of years of education does not automatically translate into developing environmentally friendly attitudes and practices. Thus, despite higher levels of education, the education factor does not strictly influence a person's choice of buying a hybrid car.

1. **Familiarity with Hybrid Car Technology:**

   Familiarity with hybrid car technology is an important aspect which is analyzed. Table 5.1 shows that it is positive but insignificant meaning that despite having knowledge of the technology and knowing its benefits, there is no vehement support for hybrid car purchases. This can be attributed to many other influencing factors such as financial conditions and personal choices that may not be environmentally motivated. Only possession of knowledge does not entail motivation to buy a hybrid car.

2. **Ownership Perception:**

   Responses about perceived satisfaction derived from a hybrid car and subsequent change in intention to buy a hybrid car in future instead of a non-hybrid car were analyzed. Though the satisfaction regarding using a hybrid car is positive but insignificant meaning that the responses are mixed. It means that the respondents even though expressing satisfaction on face may have many issues with the car usage which they were unable to state or were not too keen on carrying on with one kind of car (in case a hybrid) for coming years. On the contrary, when asked about if in future the respondents would buy a hybrid car, table 5.1 shows that this factor is significant (0.001) meaning that the respondents agree over considering the hybrid car as another choice which they can opt for.

3. **Price Perception**

   Price of any product is an indicator of affordability and preference. In this view, the regression table (table 5.1) shows that importance of prices in determining purchase choices is positive but insignificant. This is attributed to multiple influencing factors such as the prices may be of importance but a product's quality and relevance to a person's lifestyle may diminish the importance of price factor. Though when viewed through hybrid

car purchase aspect, it may be concluded that prices are not an important determinant factor in purchasing a hybrid car, but the purchase choice is influenced by other factor which may range from personal preferences, social image, peer pressure etc.

The perception of respondents regarding either hybrid car prices should be lowered compared to non-hybrid cars is analyzed as shown in the table 5.1. The perception result is negative and insignificant showing that the perception is not in favor of reduction in the prices of hybrid car. This can be due to individualistic preferences of the respondents; indifference to the product; or the choice being left on others to choose for themselves.

Furthermore, given the prices of hybrid car that are considerably high compared to non-hybrid cars in Pakistan, the respondents were inquired about their perception about purchase intentions if hybrids are expensive and if their prices are lowered. In the case of hybrids being expensive, as shown in the table 5.1, the perception regrading purchase is positive but insignificant showing that if hybrids are expensive, as is the case with any product being expensive, people will not buy them. But, the factor being insignificant shows that despite being expensive many would still tend to purchase, though the intention to purchase them would be influenced by other factors such as personal preference or the thrill to try out something new.

Sometimes one's preference for certain brands, or type of products is so strong that any change if suggested is out-rightly refused. With this view, a question was posed that even if hybrids are made less expensive, would the respondent still refuse to buy one. As shown in the regression table, this factor is positive but insignificant meaning that despite being expensive people would still tend to buy it though in contrast many would go for non-hybrids. Again, personal preferences and other factors influence purchase preferences. Till now, perceptions regarding price changes is analyzed. Since, the perception is divided over purchase intentions based on higher prices of hybrids and lowering them…it was asked if the respondents were to pay a higher price for a hybrid car. As shown in the table, the relationship is negative and insignificant showing that there is unwillingness to pay a higher price for a hybrid car but insignificance points to the notion that people may want to buy a hybrid car at a higher price though their payment of a higher price might be a result of a multitude of influencing factors.

4. Social Image:

Use of gadgets and products in daily life represent the status of a person in the society. It is pertinent to state that when intending to buy a product, a person tends to consider the social image which he/she will project because of the kind of product he/she chooses. Resultantly, ownership of materials is an important indicator of determining social status. In this view, the perceived social image of owning a hybrid car was analyzed which as shown in the table 5.1 - is done by asking the respondents about their perception regarding approval of family members on owning a non-hybrid or a hybrid car; perceiving own status when owning a hybrid car.

In the matter of family's approval of owning a non-hybrid car, as shown in table 5.1, the factor is negative and significant. It is quite in contrast to the general perception that buying whatever car, the family would approve of it but in this case the non-approval is negative and significant. This is because not always a family may approve of owning a non-hybrid car but instead any family member who either out of interest in hybrid cars or possessing knowledge may assert the buyer member to consider buying a hybrid car. Thus, the probability of buying a hybrid car through family's approval makes the relationship negative and significant.

An antithesis to the view of hybrid-car ownership is if the family does not approve of a hybrid car. The basis for non-approval can be either an amalgam of preferences and choices or hoax-type information about the demerits of owning a hybrid car. But this factor is of no significance as shown in the regression table wherein the statement that family will not approve of a hybrid car is negative and insignificant meaning that either the family has no say in the purchase matter or is in full agreement with the purchase of a hybrid car.

A person's perceived status is of immense value. It is a common practice to own and use gadgets and materials which will project status and command approval and awe from the society. In the case of hybrid cars, as the technology is relatively new despite having gone through multiple generational developments, its projection and possession is still – to some extent – viewed with skeptical opinions. Some would call it a product marketed based on environmental hoaxes or not worth keeping for it being too electrical and technical. Thus, in individualistic social setting where one is not too bound to strictly follow social practice, there is evidence of instances when possession of hybrid cars is

viewed as an act of passiveness meaning sacrificing own luxury of owning a sports car or a luxury brand just for the sake of saving the environment which is perceived not to be in danger. Likewise, it was asked from the respondents about their perception regarding if owning hybrid car would lessen their status. As shown in the regression table 5.1, the perception of hybrid car connoting a negative impact on the status is insignificant and positive. It means that while perception about one own self owing a hybrid car may not be negative, it is also of no significance what others might think of the person owning a hybrid car.

5. Environmental Aspect

Given the nature of the study wherein general attitudes and practices of people are the subject of analysis, it is pertinent to state that the way they use their gadgets presents an interesting analysis. In this study, apart from analyzing perceptions regarding self-image, price, and ownership; pro-environmental attitude is another factor worthy of scrutiny. This aspect given the limitation of the nature of the study is limited to the car usage activity. To elaborate, the respondents were inquired about their state of perception regarding the environmental aspects of their normal usage of cars with the intent to see if they were aware of the environmental aspects of their daily car usage activities.

In this regard as shown in the regression table 5.1, to get reliable response, a question was asked about their awareness regarding the fume emissions emanating from their vehicles. Thus, the question posed was in an inverse manner like "*I am uncertain about the impact of vehicular emissions on my daily life"*. The result obtained indicate that the incidence of uncertainty is positive but insignificant. It indicates to the indifference to the emissions primarily considering them as complimentary dis-benefits which can never be eliminated. Moreover, people in their normal state do not take into consideration the environmental aspect of their activity. On the contrary, another reason for the positive insignificance is that despite having knowledge of environmental dis-benefits, they do not have enough resources to shift to environmentally beneficial resources thus explaining the insignificance of the factor.

Another question asked was about respondent's perception regarding the nature of hybrid cars as more of a liability than environmentally friendly. From the obtained results, the perception is of opposite nature as hybrid cars are not considered as a liability which

proved through the significance of the factor (see regression table). Depending upon a person's affordability, personal preferences and choices; a hybrid car can become a luxury but out-rightly rejecting it as a liability is not proved in this study. Thus, the notion draws support from the literature establishing hybrid cars as environmentally friendly, but their use and purchase is based on personal, social and economic conditions.

6. Seeking environmental knowledge

It is important to understand and analyze the extent to which people are environmentally sensitive about their general activities and if they do inquire in their purchases about the products being environmentally friendly. When asked from the respondents if in their shopping activities, do they inquire about the products being environmentally friendly; the answer is in denial which is shown in the regression table (table 5.1) as negative and significant. It shows that there is no motivation in people to find and inquire about environmentally friendly products.

Another aspect is that if people are aware and concerned about the damage being done to the environment because of the products they use. Again, as shown in the regression table, the effect is negative and significant. This is because when the damage is vehemently evident and visible, and people look towards the administration to do something about it and there is no response – then the abnormality becomes the new normal causing the people to become indifferent or desensitized to the damage caused by their own activities thus explaining the negative significance.

Lastly, to conclude the respondents were asked if they would recommend a hybrid car to others. The answer is positive and significant as respondents did agree that they would recommend the hybrid car to other but when asked about the basis of their recommendation – the general response was largely based on the design and technology of the hybrid car such as low fuel consumption, the style and design which is appealing, the associated status symbol it brings along. When inquired if environmentally friendly attribute is also a positive aspect of hybrid cars, the respondents largely associated it with low fuel cost and less noise in the engine of hybrid cars.

5.2. Hybrid vs. Conventional Car Comparison

i. Economic Aspect of Owning a Hybrid Car:

The second objective of the study was to compare a hybrid car and a conventional car with the intention of analyzing the differences in the costs incurred, environmental benefits gained– if any. For this purpose, a Toyota Prius Hybrid 2018 model is compared with a Toyota Corolla 1.8 Altis 2018 model. The Prius Hybrid is taken as its sales are the highest in the hybrid car category in the country and likewise the equivalent Toyota Corolla is also taken due to it being hybrid's equivalent and having highest sales in the country (PAMA, 2017).

The Toyota Prius 2018 model marketed in Pakistan costs Rupees 6,200,000 ($50,407) and the Toyota Corolla costs Rupees 2,799,000 ($ 22,764) (Toyota Indus , 2018). The price difference between the two cars is of 3,400,000 rupees ($32,643). The values in dollar terms are calculated at an exchange rate of Rs. 123 to 1 Dollar. The fuel price taken for calculations is Rs. 96 (Pakistan State Oil, 2018). The table 5.2 below shows the comparative characteristics of the Toyota Prius and Toyota Corolla.

Table 5.2 Attributes of Toyota Prius and Toyota Corolla

Sr. No.	Attributes	Toyota Hybrid 2018	Toyota Corolla 2018
1.	Displacement CC	1798	1798
2.	Price (Rupees (Rs). and Dollars ($)) [prices are inclusive of taxes]	6,200,000 $ 50,407	2,799,000 22,764
3.	Price (Rupees (Rs). and Dollars ($)) [prices are exclusive of GST taxes]	5,146,000 $ 41,837.3	2,323,170 18,887.56
4.	Tank Capacity (liters)	43	55
5.	Fuel Economy km/liter	26	12

6.	CO2 Emissions grams/km	70	218
7.	Cost of full tank in Rupees (Rs) and Dollars ($)	4,128 33.5	5,280 42.9

From the survey conducted in the first part of this study, a question was asked from the respondents about the average distance they travel daily. The value obtained is 48 kilometers that an average driver travels in a day. Furthermore, from this value, the yearly distance covered is 18,000 kilometers by multiplying the average distance travelled daily with the total number of days in a year i.e. 365.

Additionally, keeping in view the fuel economy of both cars, table 5.3 shows the total distance travelled in a full tank by each car.

Table 5.3 Fuel characteristics of both Cars

	Toyota Prius	Toyota Corolla
Fuel Economy km/liters	26	12
Fuel Capacity (liters)	43	55
Total Distance travelled in full tank (km)	1,118	660

Source: US Department of Energy

In table 5.3, the total distance travelled in a full tank is calculated by multiplying the fuel economy number with total fuel capacity of the car. As shown in the table, the hybrid car travelled a greater distance compared to its non-hybrid counterpart. The difference in the distance travelled is 456 kilometers [1118 – 660 = 456]. To further elaborate, the total distance travelled in a year that is 18,000 kilometers would require fuel expense of Rs. 66,430 ($540) for Toyota Prius Hybrid while for the Toyota Corolla the yearly fuel expense is Rs. 144,000 ($1,170.7).

The total yearly fuel saving difference obtained from using a Prius hybrid instead of Corolla is 77, 570 rupees ($630.6). Total purchase cost difference as calculated earlier is 3,400,000 rupees ($ 27,642.3). To equalize the costs difference, a hybrid car owner who saves rupees 77,570 yearly would have to spend 44 years to cover the purchase cost

difference. Hence, fuel cost saving alone does not compensate for the wide difference in the prices of the two cars. Owning a hybrid on the pretext of costs savings may yield benefit in the long run but not in short run.

ii. Environmental benefits: Prius vs Corolla.

The average battery life of a Prius model is between 150,000 miles and 200,000 miles. For simplicity in calculation, the standard 150,000 miles that is equal to 240,000 km is taken. The 2018 Prius emits 70 grams per kilometer compared to Corolla that emits 218 grams per kilometer (US Department of Energy, 2018). Moreover, the carbon dioxide emissions have a social abatement cost which is set at $12 at 5 percent discount rate (United States Environmental Protection Agency, 2018). Consequently, the table 5.4 below presents the life time emissions of the cars.

As evident from the table 5.4, the lifetime emissions of Prius are considerably lower than that of Corolla. Against 52.32 tonnes of CO2 emitted over 14 years considering that an average driver drives 18,000 kms in a year which would take him 14 years to complete 240,000 kms – a Prius only emits 16.8 tonnes. In monetary terms, the social cost of abatement of CO2 for Prius in dollars is 201.6 dollars against 627.84 dollars for a Corolla car. Thus, the social cost to carbon for a Prius is 67 percent less than that of Corolla.

Table 5.4 Environment related characteristics of Toyota Prius and Toyota Corolla

	Prius	**Corolla**
CO2 Emissions (grams per km)	70	218
Lifetime Emissions (emissions multiplied with 240,000 km) in tonnes	16.8	52.32
Social Cost of Abatement (lifetime emissions x $12)	201.6	627.84

If the total cost for both cars is taken which includes the purchase cost and the social cost of carbon dioxide while assuming that the maintenance costs are equal for both cars, then the following results are obtained shown in table 5.5 below.

Table 5.5 Total Costs of Toyota Prius and Toyota Corolla

	Prius	Corolla
Total Cost (Purchase Cost + Lifetime Social Cost of Carbon)	Rs. 6,224,857.8 $ 50,608.6	Rs. 2,877,265.2 $ 23,392.84

Though the addition of social cost of carbon adds little to the already mammoth purchase figures of both cars, there is very little decrease in the time to equalize costs with accrued benefits. As earlier stated, the time required to equalize the cost purchasing a Prius and to gain benefits in terms of fuel savings is 44 years. Similarly, if social costs are adjusted along with fuel costs, even then the situation is not very different. The case is similar as only a small decrease in the difference is observed i.e. the amount is Rs. 3,347592.6 rupees ($27216). This amount is merely Rs. 52,407.4 ($426.1) less than the actual figure of Rs. 3,400,000 ($ 27,642.3). Even if with addition of the social abatement costs, the price differential is so great that even with fuel savings and social costs of carbon the time to equalize costs with benefits would take 44 years.

Even though it is empirically established that hybrid cars are more environmentally friendly and must be globally projected and promoted but in Pakistan's case, it high price i.e. 6.2 million rupees is rather an impedance to its positive promotion. Consequently, it automatically becomes a luxury for the rich to avail and for those who despite knowing its pro-environment benefits but constrained by financial status, affording a hybrid car becomes nearly impossible.

Chapter 6: Conclusion

For a technology to take its place in the lives people, some time is always required. It is evident from the example of smartphones which have now become an essential part of our lives. At first, they were considered a luxury but over the years their production and availability has led to mass outreach to different class segments of the society. Now they are available at cheap rates to people not having very high or high incomes. Same is the case with the hybrid car technology. For now, environmental dimensions of our social and economic outlook have started to alter our perceptions and thinking process about how we conduct ourselves in ordinary routines, which were rather absent earlier. But the environmental awareness and concern has yet to become a serious part of our thinking. As shown in this study, though it narrowly focuses on the perception of hybrid car ownership and relating it to the aspect of "environmental concern", the results do not present a strong pro-environmentally friendly picture.

Due to information boom and availability of diversified modes of information gathering, people are in fact aware of the hybrid car technology though their information quality can be considered as average – keeping in view the results of this study. This is because despite having information, either there is no environmentally motivated enthusiasm to gain further insight into the technological make-up of the hybrid car or rather having the concern to own a hybrid is not materialized due to financial constraints.

Additionally, from the analysis of responses of the respondents, it can be easily ascertained that there is no high social pressure on the people's decisions making. The individualistic nature of decision making and development of preferences irrespective of environmental consideration is rather a negative development in times when there is global consensus on the impact of harsh environmental challenges collectively faced by all of us.

In Pakistan, the prices of Hybrid cars are considerably high compared to conventional fuel engine cars. Apart from the 4rth generation Toyota Prius 2018 model which is marketed as brand new in the country, other hybrid cars such as Toyota Aqua and older generation Prius models are imported. The import price for a 2015 Prius is not that

high i.e. $ 3,962 (SBT Japan, 2018) which in rupees is merely 487,326 but the custom duty, clearance and complete expenses amount to Rs. 1,808,494 ($ 14,703.2) along with additional Rs. 55,000 ($ 447.15) – 65,000 ($528.4) required for documentation purpose. With imposition of an additional 17 percent general sales tax (GST) the price shoots to an estimated 2,762,159.4 rupees ($ 22,456.5). With such high costs of hybrid cars in the country, it is easily discernable that hybrid cars because of their high prices are at purchasing disadvantage.

The environmental benefits accrued from hybrid car use are empirically proved but the cost and benefit ratio of equalizing purchase costs with the environmental benefits takes ages to equalize. Thus, reducing the prices of hybrids will greatly benefit the consumers. It is not just the economic benefit which would be of positive value but in terms of long term sustainable development of which transport systems are a primary component – private ownership of cars because of increasing population and urbanization requires green technologies such as hybrids to gain greater popularity and preference in the society.

6.1. Recommendations:

1. Hybrid and electric cars the necessity of time for they are a tool to combat the growing negative impact of climate change. In this regard, government's policy to promote hybrid cars and electric cars would be the right step towards attaining long-term sustainability.
2. The prices of hybrid cars as shown in this study are highly inflated due to the high amount of taxes imposed on them. It would be highly appropriate for the authorities to cut down the levies on hybrid car imports making them reasonably affordable for the common man. This will not just be beneficial to the common man, but a greater benefit would be seen in reduction of carbon dioxide emissions which are on the rise due to booming automotive industry (Hussain, 2018) in the country.
3. As the challenge of climate change is real and the carbon emissions have now been understood as negative impacting agents from which no one can escape…there is need to inculcate in the people the knowledge and sense view their lifestyle through the environmental spectrum. Sensitization of the environmental aspects of their daily routines would eventually lead them to look for all those utilities which are environmentally friendly

and have a more positive impact on their lives. Hybrid cars offer one solution in the matter of sustainable transportation systems.

6.2. Limitations:

The limitations of this study include the age of the car as brand-new models of both cars: Toyota Prius and Toyota Corolla have been taken. Furthermore, only emissions during the time of car being on the road in drive state are calculated – their end of life emissions and emissions during their manufacturing have not been taken for analysis. The emissions of second-hand cars either hybrid or non-hybrid have not been analyzed because of the unavailability of the data for the users are normally unaware of their car's emissions standards.

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APPENDIX

QUESTIONNAIRE

FACTORS INFLUENCING HYBRID CAR OWNERSHIP IN ISLAMABAD: DOES ENVIRONMENTAL IMPACT PLAY A ROLE IN THE PURCHASE OF A HYBRID CAR?

ARSALAN KHALID CHANNA

MPHIL. ENVIRONMENTAL ECONOMICS

PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS

I AM ARSALAN KHALID CHANNA. I AM MPHIL STUDENT AT PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS (PIDE). I AM CONDUCTING A STUDY ON FACTORS INFLUENCING HYBRID AND NON-HYBRID CAR OWNERSHIP OF RESIDENTS LIVING IN ISLAMABAD. THE PURPOSE OF THIS STUDY IS TO UNDERSTAND AND ANALYZE THE PERCEPTIONS OF PEOPLE WHO PURCHASE BOTH HYBRID AND NON-HYBRID CARS. THE STUDY WILL TRY TO SEEK INFORMATION ABOUT THE FACTORS WHICH INFLUENCE CONSUMER'S PERCEPTIONS ABOUT OWNING A HYBRID OR A NON-HYBRID VEHICLE. IT IS THEREFORE REQUESTED THAT THE FOLLOWING QUESTIONS MAY BE ANSWERED. THE INFORMATION COLLECTED WILL BE STRICTLY KEPT CONFIDENTIAL AND IT WILL BE SOLELY USED FOR ACADEMIC PURPOSES. FILLING OUT THE FORM WILL TAKE A FEW MINUTES. YOUR HELP WILL GREATLY CONTRIBUTE TO EFFECTIVELY EXECUTING THIS STUDY.

Customer attitudes

The questions will address the following factors:

1. Self-image
2. Seeking environmental knowledge
3. Social perception associated with possession of a hybrid vehicle
4. Economic benefits of owning a hybrid vehicle
5. Importance of emissions and own contribution to emissions

QUESTIONS

SECTION I

1. **Gender:**
   a. Male
   b. Female

2. **Age:** _____

3. **Marital Status:**
   a. Single
   b. Married
   c. Divorced

4. **Occupation:**
   a. Student
   b. Public employee
   c. Private employee
   d. Own business

5. **Highest level of Education:**
   a. Matriculation
   b. Intermediate
   c. Bachelors
   d. Masters
   e. MPhil
   f. PhD

6. **Area of Highest Degree (e.g. sociology, business administration, IR, etc.):**

   _____

7. **Residential place in Islamabad**

   _____

8. **What is your monthly income?** _____

SECTION II: Car Usage

9. **How many cars do you own?** _____

10. Do you own a hybrid car? _____

11. Please state what car do you own?

a. Name: _____

b. Year: _____

c. Model: _____

12. What was the condition of your car when you purchased it? (✔)

a. Brand new ☐

b. Second-hand ☐

13.What attributes appealed to you to buy this car? (✔)

(This question holds for the car you currently own. If you own another car that is a hybrid then kindly also check (✔) the appropriate boxes under the "Hybrid Car" heading)

Sr. No.	Attributes	Hybrid	Non-Hybrid (Conventional Fuel Car)
1.	Style and design		
2.	Environmentally Friendly		
3.	Comfort		
4.	Less maintenance costs		
5.	Fuel Efficiency		
6.	Price of the car		

14. What concerns you the most when using this car? (✔)

a. Technical uncertainty

b. Uncertain about battery life

c. Unreliability

d. Any other? Please specify_____

Section III: Economic Aspect

15.How many kilometers per day do you travel on average? (✔)

a. < 30 km
b. 31 – 40 km
c. 41 – 50 km
d. 51 – 60 km
e. 61 – 70 km
f. 71 – 80 km
g. 81 – 90 km
h. 91 – 100 km
i. Above 100 km

Sr. No.	QUESTIONS	NON-HYBRID CAR	HYRBID CAR
16.	What is your average monthly fuel cost?		
17.	What is your average monthly maintenance cost?		
18.	Average speed while driving within the city?		
19.	Average Speed while driving on highways?		
20.	What problems do you normally face when using this car? (✔)		

21. Are you familiar with the term "Hybrid technology"? (✔)

Yes ☐ No ☐

22. What is your major source of information about hybrid car technology? (✔)

a. Car technician
b. Magazines

c. Friends
d. Internet
e. Television
f. Other. Please Specify _____ _____

23. How would you describe your knowledge about hybrid car technology? (✔)

a. Excellent
b. Fair
c. Normal
d. Poor
e. Do not know what it is

24. If you were to change your car, what would your choice be? (✔)

a. Petrol car
b. Diesel Car
c. Hybrid Car

25. (if you own a hybrid car) Did you get the car battery changed? (✔)

a. Yes
b. NO

26. (If yes to Q. 25) How did you dispose of the battery when you had it changed?

_____

_____

_____

<u>The following questions pertain to usage of Hybrid cars (this section demands responses regarding possibility of owning a hybrid car in the future) (✔).</u>

Sr. No	Question	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree

IV	**Ownership Perception**					
27.	I feel satisfied using a hybrid car					
28.	In future, I will buy a hybrid car instead of a normal car					
V	**Price Perception**					
29.	Prices are important in determining my purchase choice					
30.	I believe that prices of hybrids should be lower compared to non-hybrid cars					
31.	If hybrids are expensive, I will not buy them					
32.	Even if hybrids are less expensive, I will not buy one					
33.	I am willing to pay a higher price for a hybrid car					
VI	**Social Image**					
34.	I think my friends and family will approve of my choice of a non-hybrid car					
35.	I think my friends and family will not approve of my choice of owning a hybrid car					
36.	My status will affect negatively if I use a hybrid car					
VII	**Environmental Aspect**					
37.	I am uncertain about the impacts of vehicular emissions on my daily life					
38.	Hybrid vehicles are more of a liability than being environment friendly					
VIII	**Seeking Environmental Knowledge**					

39.	I usually try to find available environmental products in the market, online or otherwise					
40.	I am aware of the environmental damage caused by the products I use					
41.	Would you recommend a hybrid car to others?					