University of Rome "Tor Vergata"
Faculty of Economics

Master of Science in

Economics

Thesis in

Analysis of water consumption behavior in the European Union: are motivations relevant?

Supervisor

Prof. Mariangela Zoli

Candidate

Behzad Jeddi Balabaygloo

Academic year 2013/2014

Table of Contents

Abbreviations

EU27	European Union - 27 Member States
BE	Belgium
BG	Bulgaria
CZ	Czech Republic
DK	Denmark
DE	Germany
EE	Estonia
IE	Ireland
ES	Spain
FR	France
IT	Italy
CY	Republic of Cyprus
LV	Latvia
LT	Lithuania
LU	Luxembourg
HU	Hungary
MT	Malta
NL	The Netherlands
AT	Austria
PL	Poland
PT	Portugal
RO	Romania
SI	Slovenia
SK	Slovakia
FI	Finland
SE	Sweden
UK	United Kingdom

Introduction

Water consumption globally increased six fold during the twentieth century, and consequently accessibility and availability of fresh water turned to be one of the most critical issues for policy makers. According to the United Nations reports (2003 and 2006) although 72% of the earth's surface is covered by water, only less than 1% of existing fresh water is directly accessible for humans' consumption. At the current rate of water consumption by humans and considering the population growth rate and consequent increase of water consumption the world's water reserves are shrinking drastically. Based on the UN reports, currently, more than 800 million people are suffering from water scarcity in all over the world and the United Nation anticipated that by the year 2050 approximately 2 to 7 billion people will be left without water. Moreover, due to impacts of climate change and excessive water use the average per capita water supply will diminish by one-third during the next few decades (United Nations report, 2003 and 2006).

Specifically, water availability poses two main problems for policy makers (Khan, 2005). The first problem is related to the efficiency of the current water pricing system, whether it covers all environmental costs associated with water consumption and if it reflects water scarcity or not. The second problem is related to water pollution caused by households, agriculture, industry, etc. Including solely marginal water production or supply costs in the water pricing system does not lead to the socially optimal price of water that would provide a clear guidance for consumers to adjust their water-conserving behavior in a socially desirable way. In addition to marginal water production or supply costs the socially optimal water pricing schedule should take in to account opportunity or user costs resulted from water scarcity and reflect the costs of environmental damages. In the cases of exhaustible water reserves prices should vary over time to reflect the increased opportunity cost caused by scarcity of the water. In addition, the socially optimal pricing system has to measure the social benefits and costs of the water use.

Nevertheless, the introduction of the socially optimal price of water also has some political impediments related to equity considerations. Another important factor that affects the water pricing system is the responsiveness of water users to price changes. In general, an increase of the price of one good affects the demand of the good and the overall effect can be decomposed in an income and a substitution effect. On the one hand, as a consequence of the increase in the price of the good, the real income and purchasing power decreases, and this decreased purchasing power forces the consumer to consume less. On the other hand, an increase of price of the good makes the good to be relatively more expensive than other alternatives and this may cause the consumer to switch from consumption of the good to the cheaper alternatives. The first one is called “income effect” of the price change and the latter is called the “substitution effect”. In the case of water management, the income effect at high levels of water price could be important, while it will be minimal for price changes at lower price levels. The price change could affect the consumers' responsiveness and cause them to switch from more water consuming equipment to the new water-conserving technologies and change their wasteful habits, repair the leaks, etc. therefore the consumers' responsiveness to price change will be more sensitive when the price level is high compared to the case of low price levels. Also significant price changes will have a greater impact on individuals' responsiveness. Several empirical studies have shown that water demand is inelastic at low levels of water consumption. The water demand is irresponsive to price changes at lower levels of water consumption because water consumption up to the certain minimum level of is necessary to meet basic needs. For the consumptions up to this minimum level the water has no close substitutes, accordingly the price elasticity of the demand is around zero. As this minimum level of water consumption is fulfilled the additional unit use of water could be subject to substitution effect of percentage change in the price and the additional water consumption after such threshold could be conserved by switching to water-efficient appliances. Therefore the price elasticity of the water demand increases by water consumption levels. In addition to price elasticity of demand the pricing structure also plays a crucial role in affecting water consumption patterns. In many countries water consumers are subject to payments that consist of fixed fee and variable per unit charges. Consumers pay the fixed fees to recover the investments in the water service and supply infrastructures. In some countries the charges of additional use of water is non-linear and the price rate is different for each block of water consumption. In this pricing system the price rate is not fixed and varies as the consumption level crosses some certain thresholds. The increasing block rate scheme implies higher rate for successive blocks and consumers will be subject to higher rates if their consumption reaches certain thresholds. In other words the marginal price is zero below the allowance level but it is different from zero for the successive block and consumers should pay the penalty for overconsumption of water. To induce water consumption reduction policy makers could also employ non-price water policy instruments. Several empirical studies pointed out that these non-price instruments such as restrictions on water usage, rationing, subsidies for using water-conserving technologies, water education, labeling and metering, and public information campaigns can lead to decreases in water consumption and some of these policies may also have long lasting effects. Although policies have an important role in shaping the general water demand, socio-demographic characteristics (age, gender, income, type and size of house and families, etc.) also have noticeable impact.

Attitudinal characteristics can also influence consumer’s responsiveness to different water policy instruments. Increased awareness of the consequences of water overconsumption and scarcity of water is fundamental to stimulate policy efforts towards water problems and to make water conservation policies a priority. Policy instruments to be efficient require better understanding of all causal factors, impacts and magnitude of their influences. The policy should also take into account the socio-demographic and attitudinal characteristics, in order to evaluate whether policies should implemented only for a specific segment of the society or for the whole population.

Attitudinal factors, in particular the role of extrinsic and intrinsic motivations, were rarely examined by empirical studies, therefore this dimension requires to be more examined particularly when either the water demand has a low price elasticity, or maybe it had been made less effective because of implementing some other policies (price based or non-price based) and thus there is a need for implementing more non-price based measures. Therefore, in empirical part of this study I attempt to analyze the main derivers of individuals’ water consumption behavior, and especially concentrate on the impacts of motivations on individuals’ water consumption behavior. In the cases where the role of intrinsic motivation is important, fostering individual’s motivation could be employed as a complementary and effective measure to reduce water problems. Moreover, the role of awareness about problems regarding quality and quantity of water, specific knowledge about water problems, knowledge about water related policies, consciousness about impacts of water consumption, and some socio-demographic characteristics are examined.

Finally, to my knowledge since the drivers of individuals' water consumption behavior, specially the role of intrinsic and extrinsic motivations have never been examined by water related studies, therefore in the empirical part of this study I concentrate on potential non-price determinants of water consumption behavior, however, since still governments in their decisions about constructing policy measures consider price and income as the most effective factors, it's worth reviewing some of the previous literature in this field.

The structure of the work is as follows.

In chapter one, various empirical and theoretical studies of residential water consumption demand are reviewed. In this section I present some evidences from different water studies that investigated the role of potential determinant factors of water demand. In chapter 2 the implications of different water policy measures is provided and welfare implications are discussed briefly. In chapter 3, I estimate the impacts of various potential drivers of individuals' water consumption behavior based on a survey for EU countries conducted by TNS Political & Social on the request of European Commission.

1. Related literature

1.1 Determinants of water demand

Most of the studies, which analyze water demand, concentrated on some socio-demographic characteristics, price and non-price policy tools and their respective effects on restricting water use or reducing water pollution problem. Headley (1963) analyzes the relation between households' income and their water consumption by considering 14 cities in the San Francisco-Oakland metropolitan area. This survey covers the period 1950-1959. According to this study, there is a significant relationship between these two factors, and level of the family's income significantly affects households' water consumption. Espineira (2000) estimates the demand function for water using data from 132 towns in the North West region of Spain, between1993 to 1999. Based on this study it can be concluded that the "difference" variable[1] is considerably significant and negatively affects the water demand and this confirms the fact that water is normal good. This is also confirmed by

[1] - Nordin's difference: captures the difference between total water bill and the water bill that is issued based on the calculation of total value of water consumption using the marginal price.

significant and positive income elasticity of demand. Two variables, “Average monthly temperature” and “number of rainy days in the month” negatively affect the water consumption, but the coefficients of the estimates are lower, and thus their impacts are less important compared to other main determinant factors of households’ water consumption demand, especially in the north-west of Spain. Moreover, number of houses included in the model that are considered as the main residences have a significant and positive effect. This factor also captures the role of tourism on water consumption in the studied area. Since the area is touristic, during the high touristic seasons, summer and holidays, more tourists visit the area and accordingly consumption of the water is expected to be high, but this seasonal effect is not detected.

Wong (1972) estimated the demand for municipal water, using data from Chicago and nearby small communities in the period 1951-1961. The study also included the temperature as an independent variable that may be significantly related to water consumption in the subject region. The study came to the conclusion that income elasticity of the water demand is significant in Chicago while income changes do not affect per-person water consumption significantly in nearby small communities and suburban areas. Also water consumption in Chicago and nearby communities has meaningful relationship with average summer temperature. Demand for using water in households, in Denton city of Texas was estimated by Nieswiadomy and Molina (1989). This study was conducted using the time series of observations from these households. Random sampling method was used to collect the data. The data included two periods from 1976 to 1980 and 1981 to 1985 for the same households. During the first period the households were subject to decreasing block-rate pricing system while during the latter one the pricing scheme followed the increasing pattern. Moreover, they took in to account only the houses with lawns and without swimming pools and occupied by the same families in both periods. They concluded that households’ income and house size affect the water consumption significantly independent from the type of the block-rate scheme and also the temperature has significant impacts on water demand. Renwick and Archibald (1998) used the data from Santa Barbara and Goleta, California in order to estimate the water demand in these communities. This study examined the role of policy variables, family size and income. They came to the conclusion that family size and water demand have positive relationship. Income has significant impact on water demand. Nieswiadomy (1992), Jones and Morris

(1984), Howe and Linaweaver (1967), and Renwick et al. (1998) found similar coefficients for income. Moreover, they concluded that income has negative impact on policy responses of consumers to price increase; the higher the income the lower is the water consumption reduction by families. Therefore the policy maker's goal of water consumption reduction by means of imposing higher price will result to increase financial burden on low-income families rather than high-income ones and it raises the equity concerns and provides impediment for implementing price policy. Nauges and Thomas (2000), conducted an empirical study with the aim of estimating water consumption demand using the data for 116 eastern France communities (1988 to 1993). To this end they included variables such as average water price, ratio of over 60 years old individuals, average annual rainfall, family size, pre-tax average income, population density, local community economic activity, number of single house units, number of houses with a bath, ratio of landlords who own one or more car, the number of pre-1949 built houses and the ratio of houses built after 1982. Households included in the analysis are subject to two-part tariff scheme; in addition to per unit consumption fee that depends on water use level they also pay a fixed fee for access to the supply of water. In most of the regions of France water price depends on contracts resulting from negotiations between local municipality and private water operators, the expected water consumption by the community, socio-demographic factors in the relevant region and impacts of groups that have political power. Therefore the price of water is determined by both private operators' profit-maximizing consideration and the negotiations between local authority and private water operators. This study included variety of non-price policy instruments and found that, there is a positive relationship between houses' age and water consumption. The intuition is such that since the water infrastructures in the older houses are outdated thus the possibility of the leakage is high. Water demand elasticity of taxable income is positive but small, and water consumption is lower by the communities with greater proportion of population with age of over 60 and with higher number of new built houses. Domene and Sauri (2005) investigated the impacts of house features, behavioral characteristics, demographic factors and urbanization on water consumption using the data collected from 532 households from 22 different metropolitan area of Barcelona. Descriptive result of analyzing the data revealed that households water consumption habits do not vary significantly by varying level of income among households. Households with lower income levels consume the fewer amount of water by taking a shower because they take fewer shower during each week. Women are using more water than men in these areas and older people consume lower amount than younger peoples. They also included three types of housing as independent variable and examined if their impacts are significant. They founded that per capita water consumption in high-density households is the least one because in the high-density group of households, probably family sizes are small and there are fewer water fixtures in each house and the greater proportion of this consumed amount is for personal hygiene. In terms of water consumption amount there is no statistically significant difference between two other groups (low-density and mid-density households)[2]. Their findings are in line with expectations, housing characteristics such as housing type, family size, existence of swimming pools, presence of gardens and lawns, families' income level, non-price and attitudinal factors have significant impacts on water consumption among households of studied regions. They also found that garden size tends to be insignificant but garden facilities and design seems to be influencing. Moreover, water consumption in single detached houses is more than houses considered in high-density housing group mainly because of outdoor water use (mainly because of garden and lawn irrigations) and family size. They also examined the role of consumers' attitudes towards water conservation issues. To this end they considered some factors such as installing water-saving devices in taps, showers and toilets, comparing water consumption between periods, installing water-efficient appliances and turning off running water while brushing teeth as factors to construct an index for consumers' behavior. The data's descriptive statistics revealed that water related behavior of the studied households does not depend on their income level except for shower use; the frequency of the shower per week is more for families with higher income than households with lower income.

Mazzanti and Montini (2006) estimated households' water demand using the panel of data collected from 125 municipalities located in Emilia Romagna province of Italy covering the period from 1998 to 2001. To this end they included water price, income and selected socio-economic characteristics such as altitude, household size, share of rural area, age of population and density of commercial enterprises in the model. Their study came to the

[2] - Three types of housing was analyzed in the analysis: a) high-density housing which were apartments in multistory buildings. b) Mid-density housing covering apartments with shared pools and gardens and lawns. c) Low-density housing which consisted of condominiums and detached houses.

end that between all included variables only income and altitude are statistically significant. Moreover, they found that the water consumption is negatively affected by altitude, since the temperature falls as altitude increases.

In addition to the impact of price and socio-demographic determinants of water consumption, attitudinal factors also play an important role in affecting individuals' and/or households' water consumption behavior. Gilg and Barr (2005) empirically investigated the role of behavioral pattern on determining households' water consumption demand using the data collected from 1600 households from Devon, UK. The data revealed that more than 50% of the households indicated that they have started to take some steps in decreasing their water consumption (e.g. using the washing machine with full load, turning off the tap while brushing teeth and showering in place of using bath tub). Based on their behavior, consumers were categorized in four main groups: a) Committed environmentalists, b) Mainstream environmentalists, c) Occasional environmentalists and d) Non-environmentalists. As it is obvious from the labeling, the groups (a) & (b) have strong tendency towards environmental preservation and decreasing their water consumption; at the opposite Non-environmentalist did not share at all this behavior while occasional environmentalists' commitments towards water-conserving behavior are much weaker. Moreover they found that committed environmentalists are older than people in other three clusters and have the highest average age whereas non-environmentalists have the lowest average age. Furthermore mainstream and committed environmentalists have smaller family size and non-environmentalists have the lowest family income level. Hurd (2006), conducted an empirical study using the data of households' landscape choices for the year 2004. The data collected from three New Mexico cities, Las Cruces, Santa Fe, Albuquerque. Based on amount of water which is required to irrigate the different kinds of plants, the study identified four types of landscapes. Then households' landscape choice was defined as a function, which affected by all the variables, including number of children in families, water consumption expenditures, degree of responsibility towards water conservation and level of education. Of all these independent factors indicated in the model, number of children in families has no significant impacts while other three variables have significant impacts as expectations. Especially households' choice of landscape types is significantly affected by sense of moral responsibility towards water conservation. This study explored the impacts of households' awareness of water conservation on reducing water consumption by affecting households' choices of four different types of landscapes. These four types of landscapes differs from each other in terms of water consumption resulted from different mixture of turf that covers each landscape, whether the landscape is covered by mixture of traditional turfs which are water-consuming or they are covered by different kinds of turf which are more water-conserving. The study came to the conclusion that awareness of households about water conservation could be used as a strong policy tool in order to reduce water consumptions by households. Especially, an increase of awareness by 10% among the households increases the probability of choosing more water-conserving landscapes by 13%, which proves the fact that awareness of households about water conserving can be introduced as water conserving policy measure.

1.2 Water policy instruments

Water policy instruments consist of water pricing and non-pricing policy measures. Some studies have explored the role of water pricing policy tools: Dandy et al. (1997) estimated the water consumption demand in the Adelaide Area in Australia, using the data collected from 400 households who were mainly living in the metropolitan area (1978 – 1992). In this area systems for water pricing were two-part tariff. In this pricing system consumers have to pay fixed fee up to the certain threshold (free Allowance point) with marginal price equal to zero but after the free allowance consumption they face both fixed fee and uniform marginal price. In other words, households pay only the fixed charge if their usage is lower than the free allowance level; and thus price rate for additional consumption of unit of water is zero and their water demand depends on family size, climate, and other non-price determinants. Therefore only after the threshold households' water demand becomes responsive to the marginal price and this is in line with findings of Griffin and Chang (1990). Before 1991-1992 adjusted percentage of the value of the property determined the allowance of that property. Based on this study the most beneficial method is dependency of water consumption on marginal prices rather than using average prices. After allowance level it can be seen that all the rates are uniform but this doesn't mean that two prices, marginal and average, coincide, possibly because of the presence of allowance water consumption level. In the static and dynamic regression model employed by the study, property value along with marginal prices is utilized as a proxy for socioeconomic, physical and income variables. Moreover, after the free water consumption allowance level, the impacts of change in swimming pool ownership variable, income and climate factors are greater compared to below the threshold while the impacts of number of rooms, household size and plot size on water consumption are the same in both below and after the free allowance level. The study also included lagged annual consumption of water as an explanatory variable in the dynamic regression model. The result showed that the lagged annual consumption variable is significant confirming the fact that when households are using water-using durables such as washing machines and dishwashers, an immediate substitution is not feasible and households respond to the changes with delay and thus time has to be passed. Furthermore the study found higher sensitivity in annual water demand to price change in comparison with price elasticity of demand found by other studies and this is due to higher outdoor water consumption in Adelaide consistent with expectations that price elasticity of the demand is greater for outdoor than indoor consumption. The dynamic regression model showed that consumers above the free allowance level adjust their consumption more slowly in response to the changes in price and other variables, compared to consumers below the free allowance level. This is consistent with expectations that consumers who use more than free allowance level tend to use more water-using appliances, and as mentioned before immediate substitutes may not be possible. Finally this study empirically supported the fact that in the presence of free allowance, water will be used wastefully and the removal of the free allowance level will increase the effectiveness of water consumption reduction schemes without raising any equity concern. In Wong (1972) that is previously reviewed in section 1.1, the time series model revealed the statistically significant price elasticity of the households' water demand for suburban communities whereas cross-sectional analysis pointed price-sensitivity for all communities with small size group. Being located in the far distance from the sources of water supply, consumers that are living in the suburban area, usually have to pay more for the same water, therefore they have more sensitivity to percentages changes in water prices. Furthermore, based on cross-sectional analysis it's evident that price-sensitivity is higher in larger and more urbanized societies. But in general, water demand function in suburban areas outside of Chicago is more sensitive to price enhancement than urbanized communities. While including income, price, and temperature as causal factors in analysis didn't result in significant reduction in water consumption, some evidences showed that differential pricing system could be useful policy instrument to reduce households' water consumption. Billing and Agthe (1980) worked on data collected from Tucson, Arizona for the period of 1974-1977 in order to estimate marginal price rate for each block of water consumption. The water pricing system in the area of study is increasing block-rate scheme. They considered different model specification in the study and estimated the price elasticity of water demand in the area including the substitution effect of changes in marginal price of water and difference elasticity that captures the income effect of changes in intra-marginal rates same results was recorded in similar studies by Wong (1972) and Young (1973) that covered the same area. Also based on findings of these studies, price elasticity of water demand is statistically significant and has negative sign. The estimation of the difference elasticity of water demand reveals dependency of the result on specifications and the magnitude varies inside the interval [-0.14,-0.12]. As expected priori the sign of coefficient for difference variable is negative but it is not consistent with expectations regarding magnitude in comparison with sensitivity coefficient of income. Results show that the previous one is much larger than the latter one. Moreover, they investigated and compared the impacts of changes in nominal and real prices and income and concluded that, the most significant sensitivity between households is in relation to changes in real income & prices and actually the price sensitivity for nominal price is not that high. Chicoine and Ramamurthy (1986) conducted a study to estimate households water demand, to do so, he tested the inclusion of either marginal prices or average prices in the model, and then he used the data belonging to 59 rural water districts in Illinois to test the hypothesis. The data that was used in this survey belonged to a study that was conducted by means of telephone in 1983 and covered 100 households. In this area households are subject to decreasing block-price scheme. In the both increasing and decreasing block-pricing scheme price change impacts could be measured by taking in to account both Nordin difference and marginal price variables in to the model. Since household's are rarely familiar with the applied more complex pricing by the policy authority in the area, therefore they have no idea about the marginal price and respond to the changes in average prices but not the price rate of additional use of water unit. To estimate water demand, here they decomposed the average price into marginal price and second variable which is tantamount to the difference between average and marginal price. Furthermore, in order to estimate monthly water use by each household they considered the monthly consumption dependent on family size, two price components, quantity of bathrooms in each house and monthly family income excluding the Nordin difference variable. They found out that the second price variable is significant and affects the water consumption negatively confirming the fact that households include average price instead of marginal price to decide the water consumption level. Furthermore, the hypothesis of correct specification of average price model without including marginal price is rejected; therefore they concluded that the marginal price has a crucial role in determining of the households' water consumption behavior. At the other hand considering solely marginal price in making decision on water consumption is not sufficient. The main reason could be the fact that households spend only a very small proportion of their income as an expenditure of water consumption. Therefore both marginal and average price must be included in the model of estimating water consumption demand. Nieswiadomy and Molina (1989) examined the impacts of price change on demand for water consumption, using the panel of 101 households from City of Denton, Texas. The data included two periods from 1976 to 1980 and 1981 to 1985 for the same households. During the first period the households were subject to decreasing block-rate pricing system while during second period the pricing scheme followed the increasing pattern. Their study come to the end that water price has negative and statistically significant impacts on water consumption in both period which means that independent from type of block-rate scheme, an increase in water price reduces water consumption. Their findings do not support the Nordin's (1976) proposition. Nordin (1976) proposed that the difference variable that captures the income effect of changes in intra-marginal rate has statistically significant and negative effect on water consumption demand. These findings are consistent with other studies such as Chicoine and Ramamurthy (1986) and Schefter and David (1985). The statistical insignificance of water price could be either originated from complexity of pricing system and billing method or comes from the fact that households spend only a very small proportion of their income as an expenditure of water consumption (Henson, 1984).

Pint (1999) worked on a sample of data collected from 599 single-family households living in Alameda County, California. Based on the data they conducted an empirical study to estimate households' responsiveness to the price policy imposed during 1987 to 1992 in order to tackle water shortage resulted from California drought. In the selected area water consumption charges are calculated based on increasing block-rate scheme. The study employed two-error and heterogeneous-preferences models to investigate the impacts of price change on water demand. The coefficient estimated by two-error model is considerably greater than estimated coefficient by heterogeneous-preferences model. Although the estimated impacts of price changes are small, the relatively large increases of the price across the blocks reduced water demand significantly during 1990-1991. While other quantity–based water systems in California imposed considerable losses in revenue, which in turn forced the policy makers to increase water prices to reduce water consumption in following years, the price increase policy increased the revenue. Finally the study concluded that although price elasticity of demand is small for Californian, by an excessive price increase they become responsive and their water demand will be relatively elastic. Therefore relatively irresponsive consumers could become totally responsive when they face unusually large increases in water prices. Dalhuisen (2003) conducted an empirical study to address empirical variations in impacts of income and price on residential water consumption demand. To this end the study collected a sample of data for the period of 1963-2001 covering estimations of water demand price and income elasticities estimated by 64 different water consumption studies. This study declared that water tariff structures are the main reason for empirical price and income variations; under the decreasing block-rate water pricing scheme relatively higher price elasticity and lower income elasticity of water demand is forecasted. Furthermore, although it seems like price elasticity of water demand doesn't depend on pricing system, but a decreasing block rate scheme leads to enhancement in water demand's income elasticity. Another important finding is that, if we use average price in place of marginal price, water demand's price and income elasticity are enhanced significantly as it is shown in estimations. Also Nordin difference variable does not have a significant impact on water Demands' price elasticity, whereas it influences significantly the income elasticity. But we should keep in mind that, inclusion of discrete-choice specifications only affects price elasticity of water demand.

Another interesting finding is that higher levels of income are correlated with higher net value in income and price elasticities. This is consistent with the findings of OECD (1999) based on which, net value of the water demand's predicted price elasticity is smaller in the United States than Europe.

Renwick and Archibald (1998) used the data collected from Santa Barbara and Goleta, two communities from south California in order to estimate the water demand in these communities. They also examined the impacts of price changes implemented to tackle with serious water shortage. The first water pricing of Santa Barbara is introduced in June 1989. At first the fixed per-unit uniform price rate replaced by moderately increasing block-rate pricing scheme, then after some months a steeply increasing price scheme is introduced. City of Goleta's moderately increasing block-rate water pricing scheme is replaced by relatively high uniform rate after more than a one year in July 1990. Their study came to the end that the coefficient of price is statistically significant and has negative sign which is consistent with price elasticity of demand that is estimated by Berk et al. (1980).

Renwick et al. (1998) estimated the residential water consumption demand using the data collected from eight communities in California. They studied the impacts of management policy tools in the non-price demand side like rationing, subsidies for water- conserving technologies, restrictions on water consumption for instance in landscape irrigation, public education campaigns, block-pricing schedules, weather and climatic factors and some socio-economic characteristics. This study concluded that during summer, an increase in water price by 10% leads to reduction from 1.6% to 2%. This reduction is smaller in magnitude than the estimations of Renwick and

Archibald (1998), Renwick (1996) and Berk et al. (1980). The difference in estimations of severity of impacts of water price change on water demand may be originated from exclusion of demand side management policy instruments.

Espiñeira (2000) included determinant factors such as Nordin difference, temperature, income, household size, monthly precipitation, quantity of water units (in m3)that they have to pay for without considering the real consumption, quantity of periods that are each covered with a bill, proportion of dwellings considered to be main residence and share of population over age 64, in order to estimate water demand function based on the data collected from 132 towns located in Spain (north-west region) in the years between 1993 to 1999. Water pricing system in the most of the towns of selected area was tariff schedule which imposes fixed payments for consumptions under free allowance level and single price rate for the first block after free allowance level of consumption or increasing block-rate for several blocks. Since water consumption up to the allowance level is free, therefore marginal price of water and thus price elasticity of demand is zero implying that changes in water prices do not influence water usage decisions. With the exception of one model, all models that employed to estimate price elasticity of water demand concluded that the price impacts are small and are not statistically significant. For water consumptions beyond the free allowance level the water demand is expected to be responsive to changes in prices. This expectation is satisfied in this study. Estimations based on only monthly average water consumption above the free allowances confirmed the expectation. Finally the study suggested that a) the water consumption demand is elastic beyond the free allowance level. Moreover, the average consumption of water depends on the locus of minimum allowance point. In other words the greater the minimum free allowance level the higher will be the average water consumption. b) Responsiveness of consumers has positive relationship with water consumption level. In other words, the more water consumption level, the higher will be the degree of response. c) Consumers won't be interested to figure out the exact value of the marginal price of the water at lower tariff rates. d) Within the minimum water consumption level, the average water price clearly presents the water consumption demand. e) At the consumption level above the free allowance point household's become interested to find out the exact value of the marginal price and employ that value in determining their responses to price change. Taylor et al. (2004) tried to estimate water demand function based on the data collected from 34 municipal water utilities located in Colorado covering the period of 1984-1985. They also examined that between marginal and average prices, which one should be included in water demand estimation models. In estimation of the water demand function some variables such as average price and/or marginal price, annual income, monthly precipitation, water pricing system (e.g. increasing or decreasing block-rate schemes, flat-rate pricing system and non-meter monthly fixed fees), water conservation program and higher annual temperature are examined and demand function is constructed on a per-connection basis in place of using overall amount sales. They found that under block-rate pricing system the price of the water depends on water usage level. In the estimation of the water demand by marginal price they figured out that the price elasticity of demand belongs to [-0.3,-0.2]. But if marginal price is replaced by average revenue in the estimations, the coefficient of the price becomes -0.4. The explanation of this difference is the fact that the average revenue variable takes in to account the fixed monthly fee, which is not included in marginal price. This is confirmed by removing the fixed monthly fee from average revenue variable, which resulted in insignificancy of the average revenue coefficient and more interestingly the sign of the coefficient has changed. Therefore estimating water demand function by marginal price is more appropriate than by average revenue variable when fixed monthly fees are present. As a whole, the findings suggested that water consumptions under increasing block-rete scheme is less than constant rate pricing system but water consumption is higher under both non-metered fixed monthly fees and decreasing block-rate scheme. More precisely, in comparison with consumption level under constant rate pricing system, the water consumption is 16% lower under increasing block-rate schedule, 31% higher under decreasing block-rate schedule and 83% higher under non-metered fixed rates. Moreover, regardless of water pricing type, water pricing system is found to be more efficient than water-conservation programs; based on findings, water-conservation program has no significant impacts on water demand.

Nauges and Thomas (2003), conducted the time series analysis of data collected 116 communities from France covering the period of 1988-1993 to estimate water demand function. In the selected area the water pricing system is two-part tariff system with fixed fees for connection to water supply infrastructures and per unit price of water consumed. They employed a dynamic regression model to figure out if any relationship between current and past water consumptions exists. Furthermore they studied the existence of quick responses to the water price changes and long run impacts of price changes on households' water consumption adjustments. The interesting conclusion resulted from this study; they found that the long-run price elasticity of the water demand is 1.5 greater than the price elasticity of the demand in the short run implying that households will be more sensitive if they perceive that an increase in price will last for a longer period. In other words, if consumers believe that the increase in price is permanent and persistent they will reduce their consumption significantly. Furthermore, they estimated that the income has positive and significant impact on water consumption and the income elasticity of the demand is 0.51. Findings showed that responses to the increase in price need one year time, because first of all finding the excessive water-consuming sources needs time, and even after identifying the water-using sources consumers respond with delay in most of the cases immediate replacement of durables such as dishwashers, swimming pools and washing machines is not feasible and transition to efficient water-using durables is time consuming. In addition to the conclusions regarding the impacts of variables that are discussed in previous section the effectiveness of the pricing scheme could be assessed by inclusion of the average prices in the model considered in Domene and Sauri (2005). Water pricing systems in the selected metropolitan regions of Barcelona commonly involve a fixed fee plus several increasing blocks. Since approximately half of the studied households declared that they do not look at bills and compare them with previous ones and since most of the households do not understand the details of water tariff system imposed by their municipality and due to presence of heterogeneous pricing structures in the studied area, marginal price is replaced by average price in the estimations. Finally their findings showed that average price does not affect households' water consumption level significantly which may be due to the fact that usually a small part of Families income is spend on water. Which is why, average price is not an important factor in determining water consumption behaviors. For estimating water demand function Espiñeira and Nauges (2004), used the data collected from Seville, Spain, covering the period of 1991-1999. During this period the selected area was suffering from severe water shortage and drought. In addition they estimated the minimum water consumption[3] level based on the data; the price elasticity of the water demand function is zero for the consumptions up to this level. Water pricing system which is employed in the selected area consists of fixed payments and an increasing block-rate scheme with only three blocks of consumption. They assumed both marginal price and households' monthly water use as independent variables and regressed them on monthly precipitation, monthly virtual income[4], Limited daily hours of water supply which is introduced to tackle the water shortage (this policy employed when the area was experiencing severe drought), prohibited outdoor water use and population density. The minimum water consumption level is estimated by 3 cubic meter per person per month, which is less than monthly per capita average water consumption (6.4 m3), this implies that the price increase and consumption restrictions could still force Sevillan households to reduce their water usage. The study also suggested that for the consumptions above the minimum water usage level, other non-price policy instruments such as information campaigns or encouraging use of instruments with low-water consumption would be beneficial and policy makers should concentrate on non-price policy instruments. Cummings et al. (2005), used the data collected from 50 public water utilities located in 28 coastal counties in Georgia covering the period from 2003 to 2005. Each selected water utility has its' own specific water pricing system which are mostly block-rate pricing scheme. Using the data they derived each household's monthly average water consumption, monthly paid price by average household and marginal quantity[5] of water that was used by usual household in January and July. In this model which is employed to estimate water demand function, the marginal water quantity is defined as a function of marginal price (per thousand gallons), Nordin

[3]- the minimum water consumption level could be considered as consumption for basic needs such as cooking, drinking, toilet and personal hygiene.
[4] - Virtual income is defined as differences between Nordin difference variable and average salary.
[5] - the marginal quantity of the water consumed by average household is the extra amount of consumption beyond the range of the last block.

difference variable and median household income. The findings showed that Nordin difference variable and income don't have statistically significant impact on water consumption demand, whereas marginal price is relevant and its' impacts increases by price. Similar to results of other surveys, water demand is inelastic at low prices while it is elastic at high prices; specifically, in January the water demand is more elastic to marginal prices. Results confirmed the most common finding by other studies which are inelasticity of the water demand at low prices level and elastic water demand at higher level of prices. Although the water consumption demand is insensitive at least for a certain price range, pricing systems have impacts on water conserving behaviors at the margin. Olmstead et al. (2005), conducted an empirical analysis to figure out that whether increasing block-rate water pricing schedule is more effective than uniform rate pricing structures or not. To this end they used the data collected from 1082 households covering 11 urban areas in United States and Canada, which included 16 water utilities. In this area 26 different water pricing methods were used, like 2-tier increasing block-rate pricing schedule, 4-tier increasing block-rate pricing schedule and uniform pricing structures. under increasing block-rate schedule ,in discrete choice model the price elasticity for water demand is estimated to be -0.64 for the households, which is significant; in the panel random effects model the price elasticity of water demand for the households under the uniform-rate pricing schedule is estimated to be -0.33, which is also statistically significant. By comparing the two methods, we can see that higher price elasticity of the demand under increasing block-rate schedules shows that increasing block-rate schedules are more effective than uniform-rate water pricing scheme in reducing households' water consumption. the effectiveness of water pricing policy also confirmed by Hurd (2006); In the selected cities most of the landscapes in residential areas are covered by traditional turf grasses that cause the higher per-capita water consumption. Since 35% to 70% of current per-capita water consumption is attributable to these traditional grasses and outdoor water consumption, therefore by replacement of those grasses by traditional bluegrass type landscapes and outdoor water improvements, 35 to 70% of per-capita water consumption could be conserved. Moreover, the study found the meaningful relationship between water consumption costs and households landscape choice.

Since the traditional water-using turf grasses increases water consumption substantially, subsequently the water consumption costs increase as well, so policy makers could force households to consume less and switch to more water-conserving landscape by means of water price increase policy. In other words, higher water costs affect households' decision of landscape choice considerably.

Water reform policies were implemented in 1994 in the area of the interest of study by Mazzanti and Montini (2006); These policy reforms were based on two main principles; first, the water prices should reflect the long run water provision costs, second, the water supply services should be privatized in a gradual way. As an immediate consequence of implementing the water policy reform, water prices increased in the area of interest (e.g. an increase in nominal water prices was 8.9 percent for the period 1998-2001). In Emilia- Romagna the water pricing schedule is based on an increasing block-rate water pricing system. They used the medium block's price of water pricing system instead of marginal prices in the estimations because the data of marginal prices is not covered by the employed dataset. According to the findings of the study price changes have statistically significant and negative impacts on water consumption demand in the area of study and households are very responsive to price changes; more precisely, by inclusion of only income in the model a 10% water price increase reduced water usage by households by 11%, whereas inclusion of income and selected socio-economic variables in the estimation model caused the more reduction of water consumption by 13%. The explanation of estimated higher and statistically significant price elasticity of water demand could be the fact that water rates are relatively high in Emilia-Romagna in comparison with other Italian provinces.

Also the role of water non-pricing policy measures have been examined by some water related studies. Previously reviewed study by Renwick et al.(1998) also examined the role of demand-side management policy schemes. The study scrutinized the impacts of six types of Demand-side management policy programs[6]

---

[6]- above mentioned policies include: a) rationing of water between households, b) subsidies for adopting more water-efficient technologies, c)making sure that local water departments are in compliance with special water conservation methods, including dye tablets for leak detection, a low-flow showerhead and tank displacement devices, and d) forming campaigns for enhancing public awareness, e) special limitations on

that employed by policy makers to tackle the severe drought experienced in the area of interest from 1985 to 1992 in order to encourage households to undertake water-saving actions. In the employed regression models they also included some other determinant factors such as weather and climatic variables, price variable, lot size and socio-economic characteristics which are common in empirical studies of water consumption demand by households. The study figured out that implementing public information campaigns causes the reduction of 8% in households' monthly average water demand while implementing retrofit subsidies reduces it by 9%. On the other hand imposing the water rationing policy and restrictions on specific types of water usage could result in reduction in monthly average water demanded by households respectively by 19% and 29% which are significant. Also the coefficients estimated for measuring the compliance with the local water department policies and offering promotions to encourage adoption of water-efficient technologies are not statistically significant. Another noticeable finding in the study is that the net value of the stringent policies' coefficients are greater than those coefficients estimated for policy tools that encourage households to voluntarily engage in water-saving programs, therefore it can be concluded that in reduction of water consumption demand by households, effectiveness of imposing restrictions on water usage is higher than implementing public information campaigns. Therefore non-price Demand-side management policy tools could be regarded as an alternative measures in order to reduce water demand. In general, the study suggested that if a moderate reduction in water consumption is the target of policy makers (e.g. 5% to 15% reduction in water usage), they could achieve their target by means of implementing Demand-side management policies which encourage households to voluntarily participate in water-conserving program such as public information campaigns or by imposing the modest price increase policy. On the other hand, if a larger reductions of more than 15% in water demand is the aim of policy makers, it could be achieved by more stringent mandatory policy tools such as restrictions on water use or by a larger price increases. Creedy et al. (1998) studied the impacts of group metering

some kinds of water consumption, like prohibiting peak hours irrigation of landscape, and f) distribution of free retrofit kits.

water policy system using the data collected from the households living in west Australia. In the area of the interest households are subject to group metering water pricing system. As a consequence of possibility of free-riding acts under group metering system, water consumption level is expected to be greater than consumption level under single metering system. Free-riding could emerge in group metering system due to the possibility of occurrence of inconsistency in determining and dividing each group member household's share of costs imposed by an increase in water consumption by the group as a whole. More precisely, although only the group member households who used the additional water benefit from an increase in water consumption, the additional costs of increased amount of water consumption are imposed to all households of the same group, independently of their water consumption level. The problem of free riding leads higher level of water consumption by households than the cases in which households are under other more effective pricing policies. The theoretical expectation of excessive water consumption in the presence of free-riding under group-metering policy system is not supported by study's empirical findings. This inconsistency between theoretical expectation and empirical findings in the presence of free riding under group metering could be explained by the fact that since in the studied sample the water price are very low, thus identifying the source of variation in water consumption is ambiguous. In other words it is quite difficult to measure the amount of increase in water consumption that is solely attributable to the presence of free riding. Renwick and Archibald (1998), explored the role of some non-price determinant factors of demand-side management such as low-flow toilets, low-flow showerheads and water-efficient irrigation measures. Based on the data covering the period from 1985 to 1990 collected from south of California they studied the residential water consumption demand model including price and non-price variables and selected socio-economic characteristics. During the studied period California has been experiencing a very severe drought. The resulted water shortage forced the local authorities to tackle the problem by experimenting different price and non-price policies. Policy makers in Santa Barbara distributed the low-flow showerheads freely and offered rebates for the adoption of low-flow toilets in 1988 in order to manage the Demand-side of water. One year later, they employed a moderately increasing block-rate pricing scheme and, then in 1990 they adopted a steeply increasing block-rate pricing scheme. Moreover, in 1990, the local policy makers strictly banned the specific water consumptions especially in landscape irrigations. Moreover, the local authorities of Goleta also imposed some different Demand-side management policies such as distributing low-flow showerheads among households freely and promoted use of low-flow toilets. In 1990, moderately increasing block-rate pricing schedule was replaced with a high uniform rate. Besides from that another "mandatory water allocation" policy was implemented by local authorities in 1989. By introducing his policy households with excessive water consumption must pay a penalty of higher marginal prices. Households showed positive responsiveness for toilets and showerheads with low-flow and irrigation methods with higher water efficiency that is considered as water-efficient technologies. In general, households' water demand is found to be responsive to price changes, but the degree of responsiveness of households depends on the level on income. They concluded that each introduced Demand-side management policies is relevant. As a consequence of imposing restrictions on the specific water usages such as landscape irrigations water consumption showed a reduction of 28% by the average households living in Goleta, and a reduction of 16% by the average households living in Santa Barbara. 10% reduction of water consumption is observed as a result of using low-flow toilet by households while 8% reduction of water consumption resulted from employing low-flow showerheads. They also found that water consumption is negatively affected by employing water-efficient irrigation technologies and reduced by 11%, while the use of traditional irrigation technologies has positive relationship with water consumption in increase it by 9%. Moreover the study found that the Demand-side management policies can effectively encourage consumers to undertake water-conserving actions as pricing policy tools do. Furthermore, they identified the existence of the link between density and degree of responsiveness by households attributable to non-price Demand-side management policies. Non-price Demand-side management policies have significant negative impacts on water usage by households living in low-density areas supporting the fact that since households living in low-density regions own large landscaped areas and accordingly their water demand is higher and thus there is more room for Demand-side management policies to induce households to change their water consumption plan. The adoption of water-efficient technologies leads water consumption reduction of 10 % by high-density households which are considerably lower than the percentage of water consumption reduction of 31% in low-density regions and this is consistent with latter result. In general the study concluded that the power of both pricing and non-pricing policy tools in affecting households' water consumption pattern depends on their characteristics. Nauges and Thomas (2000),used data belonging to 116 municipalities in the east of France between 1988 to 1993 to estimate water demand function and examine the impacts of some price and non-price policy tools on water demand of households. According to the findings since the price elasticity of demand is found to be statistically insignificant for selected area, thus implementing price increase policy is not an effective tool. More precisely, an increase of 10% in prices leads only a reduction of 2.2% in water consumption demand. Based on this finding the study suggested that other non-price policy tools like campaigns increasing public awareness, increasing education about water conservation, and low-flow fixtures and equipment promotion could be used as an effective policy tools to achieve water consumption targets. In addition, the consumption of less water is observed by people who are live separately in their own houses and therefore have access to their own meters. Therefore providing knowledge about own meters will increase the awareness about water consumption and accordingly will result in a better and more effective water management program. This conclusion is consistent with findings of some other studies such as Herrington (1997), Edwards (1996) and Mid-Kent (1997), which are suggesting that individual metering reports could be used as effective tools in water consumption reduction programs.

The study by Espiñeira and Nauges (2004), suggested that since the price elasticity of water demand is insignificant up to the threshold which represents only the minimum amount of water consumption, so water price increase policy is not effective to induce water consumption reduction. Therefore other non-price policy measures could be effective alternatives in reducing water consumption below the minimum necessary amount. These non-price policy measures also could be used as a supplement for price policy tools when the consumption is above the threshold and thus the demand is responsive to price changes. Therefore in addition to determinant factors such as income, marginal price, monthly precipitation and population density which are most commonly used by empirical studies the study included and examined the impacts of two non-price policy tools like supply restrictions and bans on outdoor water usage. The study figured it out that supply restrictions have significant impacts on water demand reduction whereas bans on outdoor water usage have no significant impact. More precisely, daily one hour supply of water reduced water consumption which is tantamount to amount of reduction that would be resulted by 9% increase in water prices. This considerably significant impact of supply restrictions on water consumption reduction enhances the importance of this non-price policy tool in the absence of sensitivity of the households' water demand to price changes policies for the consumption levels below the minimum water usage[7]. Gaudin (2006) conducted an empirical study in order to figure out whether providing clear-cut price information has significant impacts on water consumers or not, based on the data collected by household interviews and from the American Water Works Association (AWWA). In order to estimate annual per-capita water consumption the study included some determinant factors such as income, households' average size, temperature, population density and average water price as independent variables in the model. Two kinds of variables are used in the model in order to explore the existence of different information types. The first type of variable consists of water billing characteristics such as quantity and price information variables and the variables which are related to other billing aspects that could affect water consumption by responses to the price changes, whereas the second type variable consists of other billing characteristics that could influence the water consumption demand via non-price policy tools that changes individual's preferences. The price independent water conservation aspect of usage can be considered as a second type variable. Consistent with other empirical studies' findings regarding some common variables such as marginal price, income, household size, density, monthly precipitation, and temperature, this study also came to the end with the same

[7] - The minimum level of water consumption for each month is estimated to be approximately $3m^3$.

conclusion that most of them estimated to be significant. In addition to those findings, this study concluded that information variable affects positively the responsiveness of households to price increases. Particularly, the absolute value of price elasticity of water demand increases by insertion of information about marginal price of water on water billings. Therefore for a targeted amount of water consumption reduction, policy maker could increase the price of water by 30% less in the presence of information about the marginal price on the bills, provided that the price elasticity of the demand remains constant. The study by Hurd (2006), also explored the impacts of households' awareness of water conservation on reducing water consumption by affecting households' choices of four different types of landscapes. These four types of landscapes differs from each other in terms of water consumption resulted from different mixture of turf that covers each landscape, whether the landscape is covered by mixture of traditional turfs which are water-consuming or they are covered by different kinds of turf which are more water-conserving. The study came to the conclusion that awareness of households about water conservation could be used as a strong policy tool in order to reduce water consumptions by households. Especially, an increase of awareness by 10% among the households increases the probability of choosing more water-conserving landscapes by 13%, which proves the fact that awareness of households about water conserving can be introduced as water conserving policy measure.

1.3 Intrinsic and extrinsic motivations

Effectiveness of water policy measures in influencing water consumers and changing their water consumption pattern requires the inclusion of both intrinsic and extrinsic motivations. Frey (1999) studied theoretically the morality and rationality in environmental policy. To this end the study considered two different groups, "Moralists" and "Rationalists", where the first group believe that nature is highly valuable and humans must take environmental preservation seriously, even if this jeopardize their short time goals. This belief may lead to co-dictatorship because is founded based on necessity of preserving environment even if the person doesn't believe in it, he/she must be made to take part in this process. The other group of though called rationalists is composed of technocrats and economists. Technocrats believe technology can save environmental problems, whereas economists believe humans can overcome environmental problems if the right incentives are used for it. Although these groups of thought look far from each other but still are related on some levels. Moralists used to believe that environment preservation must be 100% based on internal motivations, but now have changed their position significantly and accept and suggest use of market based ways and policies to increase this motivation. Economists believe that incentive-based policies are much better than any other market policy, although their implementation is hard. Therefore it can be said that these two different views are actually depending on each other and are inter-related. Frey (1997, a) has discussed the interrelation between intrinsic motivations and use of economic motivations based on morale incentives in Crowding Theory. There are some important points to be considered in this matter: First is "hidden cost of reward" in which imposing an extrinsic motivation would eliminate the intrinsic motivations for individuals that are already intrinsically motivated.

- The external motivation could be introduction of a reward, or implementation of a new law.
- If the external motivation has the form of the dominant controlling power it will minimize the effect of intrinsic motivation, but if it has the form of increasing awareness and informing it will promote intrinsic motivation.

External motivations may have another kind of indirect influence on intrinsic motivation. If the crowding out of internal motivation by external motivation happens in major areas, this will affect other areas' intrinsic motivation too, although no external motivation has been imposed on those areas. This indirect motivation spill over would require the side effect brought by external motivations. There are several examples of this spreading effect, in which the expectance of extrinsic motivation stops people from being self-involved, because now they are used to it, and will not for example preserve environment unless a reward or a regulation makes them too. Several experimental researches such as Cameron and Pierce (1994) or Cameron and Eisenberger (1996) challenged crowding out theory and concluded that this theory is not true. However, in a waste study by Deci, et al. (1999), these claims were denied and the robustness of "crowding out" was proved. The effecting process of crowding-out is described below:

- Self-determination is lowered, since external motivation replaces internal motivation. If as mentioned before the external intervention perceived as a controlling measure. Otherwise it can have an encouraging effect.
- Since previous norms are changed therefore reciprocity is violated.

If an individual is aligned with his external environment and friends' personal relationships, this could increase his/her intrinsic motivation. Since communication increases awareness and mutual acceptability of opinions, this could be used to increase intrinsic motivation. Increasing employees' participation in decision making power would lead to increase in their responsibility in adoption, and self-determination. Based on another study by Grant (1996), unless its cost is high, generally people would take part in environment preservation activities. Different policies that have been undertaken till now are mentioned below with their related effects on environment preservation.

- In case the legislatives foresee a punishment against anti-environment acts, this would decrease self-motivation, in the case that environmental violations are usually hard to be observed and even then the punishment can be delayed, and finally even if proved, environmental law is not usually strong enough and are bring a relatively small costs for the violator. The size of this punishment could increase but this could lead to an ever increasing web of regulations, in order to avoid this, the way to increase intrinsic motivation is preferred.
- Environmental taxes also have crowding out effect in smaller scales. Although these taxes make it clear that pollution (in our case water pollution) is not a accepted behavior, but still people who pay taxes would believe that it is no longer their responsibility and now the locus of control is transferred to government.
- Low/high environmental taxes are having better influence than intermediate tax rates. Low environmental tax rates, imposes little cost for environmental abuse so, consumers don't feel controlled by government and feel the responsibility on their own shoulders. It has a structure that promotes intrinsic motivation. High taxes, on the other hand, have a different mechanism, since they make environmental abuse too costly for individuals. This method is useful when environmental morale is low from the beginning. But in case low taxes have a little environment preservation

effect, then raising the taxes is productive up to an optimal level and after that threshold any further increase in the taxes would worsen the situation.

Since the effectiveness of intrinsic motivation is well-known, we need to focus more on the ways to promote intrinsic motivation; in the short time we can foster it by increasing participation and awareness, but long term solution is represented by education. Although not very fast, cultural actions actually increase people participation and willingness to contribute to environment preservation. But it is necessary that consumer observes and understands the exact effect of the actions on environment and the effects are not hidden in the process. The next factor that influences intrinsic motivations is the social effect (Baumol & Oates, 1979); if a consumer observes that his acts are exploited by others selfish behavior this would lead to decrease in their self-motivation. Therefore sustaining the intrinsic motivations is really hard. Needless to say that environmental policy can not only depend on morale variables.

During time two different perspectives about how to preserve environment (moralists and rationalists) have reached a mutual agreement point, since policies only including rules is not effective and relying only on intrinsic behavior is not sustainable or even enough. Successful environmental policy uses both these tools and methods simultaneously. The efficiency of imposed rules would increase by adding consumer awareness through informative tools, especially in case tax method is used. By involving individuals in decision making process their internal motivation would increase, Frey (1999). Furthermore, local level decision making is another method to increase cooperation, since local authorities are usually more aware of the problem and its conditions, they can prescribe a better solution, and better inform the local consumers and this would increase their willingness to cooperate in environmental preservation. Therefore a water conservation plan that is designed by local authorities can better address local water issues.

Since in the water problems hierarchy, waste water and water pollution stays in the second place as a worst phenomenon after the scarcity of the water resources, considering all of above mentioned factors in defining water policies would help to reach a more effective water policy. Influencing water consumers and changing their water consumption pattern is a process that requires the inclusion of both intrinsic and extrinsic motivations.

Generally consumer's personalities are different from each other and this affects their natural openness to trying and adopting new phenomena. As it has been explored by many authors, Frey (1999) suggested that an effective environmental policy needs to take in to account both intrinsic and extrinsic motivation. The main question that remains with no clear answer is the way to use these factors to promote the individuals to take part in environmentally friendly procedures. Both intrinsic and extrinsic motivations play an important role in determining consumer's decision. As it's clear, intrinsic motivation simplifies the path towards committing environmental friendly actions and using more efficient technologies. Since the person who cares about the environment, he/she will continue to act based on this belief even if a small cost is involved. According to Frey & Jegen (2001) employing communications which are strengthening environmental morale could improve intrinsic motivation. But since intrinsic motivation cannot be easily sustained it must be backed up by supportive legal or financial incentives. external incentives however, include mostly the financial incentives, which as discussed widely before can have a negative effect on intrinsic motivation of people, based on crowding out theory and make them indifferent to environment preservation in absence of these motives or in some cases even increase their pollution and other related damages (Frey, 1999, page 411). Therefore a socially effective policy should take in to account motivations and complement the intrinsic incentives with financial and legal incentives. Careful consideration must be made to makes sure extrinsic motives do not crowd out intrinsic motives. The compensation (reward or punishment) system must be personalized and relative to performance, because general and non-specified cost would be treated as fixed costs and this will not have a good impact on environment (Gneezy & Rustichini 2000), the important fact is to make sure that extrinsic motives are not chosen in a way to crowd out intrinsic motivation, since in the long run it would not benefit the environment.

Based on the study by Raymond De Young (1986), people engage in environmentally friendly activities for variety of reasons, but intrinsic behavior seems to play an important role in preserving environment by individuals. The more people are internally satisfied and motivated about green acts, the more they will engage in conservation and this should be considered in policy making decisions, therefore it would be wise instead of using the whole budget that is usually used to make policies based on extrinsic motivation, it would be better to increase peoples knowledge about the effects and satisfaction that environment preservation would bring to them. The real motivation for preserving environment lies within every human being; since environment affects them every second the need to survive makes this satisfying.

Chapter2

Implications of water policy measures

2.1 Welfare implications of water policy measures

Woo (1994) compared the welfare implications of different water policies that are employed by policy makers in order to tackle the water shortage problem in the supply side. With the aim of dealing with the extreme water shortage the Hong Kong water supplies Department employed three different water service interruptions during the period 1973-1990. These three service interruptions are applied to all community members and all commercial entities and all residential buildings. To alleviate the adverse effects of service interruption policies, before implementing them the information circulated widely in the societies. In the employed water consumption model the monthly per person water consumption considered to be dependent on some variables such as per capita income, monthly average price, temperature, and hourly water supply. Furthermore, using the results of the model the study computed the welfare loss caused by application of three service interruption policies. In addition this study also computed the welfare loss that is associated with an increase in water price, provided that the magnitude of water consumption reductions is the same in both cases. At the end, the study came to the conclusion that per capita monthly welfare losses associated with applying the three water service interruption policies are significantly large and more specifically belongs to the interval of [221USD, 1607USD], whereas an increase of water price to reduce the same amount of consumption reduction imposes monthly per capita welfare loss equal to just one USD. Therefore comparing these two amounts of welfare losses imposed by two different policies, it can be easily concluded that implementing water service interruption policies is not the least costly way of achieving the water reduction target and imposes a very large monthly per capita welfare loss and thus water shortage needs to be addressed by a better and more efficient policy tools. Based on the results since the welfare loss associated by an increase in water prices to reduce the same amount of water consumption is the minimal one, therefore it can be concluded that price change policies could be used as more efficient policy tool to deal with the water shortage problem in a least costly way.

Hensher et al.(2005) carried out an empirical study in order to find out consumers' desire to pay for uninterrupted supply of water services, based on the data collected from the study conducted in Canberra, Australia. The study came to the conclusion that consumers living in the area of interest and are under experiment are willing to pay for continuous water service and reduction of water service interruptions both in frequency and the duration. Furthermore, a negative relationship between consumers' marginal willingness to pay for a reduction of number of water service interruptions and the annual frequency of water service interruptions is identified, meaning that the more the frequency of annual water service interruptions the lower will be the marginal willingness to pay for water service interruption reductions. For instance if the water service interruption occurs twice annually, the marginal willingness to pay for interruption reduction by consumers will be on average 41.5 Australian Dollar while, if frequency of water service interruptions increases and interruption occurs monthly the estimated marginal willingness to pay by consumers falls from 41.5 AUD to 9.6 AUD for the reduction in the frequency of the interruptions. Finally, findings showed also that consumers are willing to pay also for shortening the duration of the water service interruptions and more interestingly they declared that in exchange to prior notice of water service interruptions they are willing to pay an amount that is equivalent to average of 19% of their current bills.

2.2 Implications of various water policy measures

When reviewing previous literature it becomes obvious that in estimating the impacts of price and non-price determinant factors on water consumption demand almost all of them have come to common results. Between them, changes in the price are identified to be the most significant determinant of water consumption demand. The impacts of changes in price are captured in water demand's own-price elasticity; the own-price elasticity of the demand represents the sensitivity of the residential water demand to increases in the water price. If the own-price elasticity is relatively high, then water price change could be used to induce consumers to reduce their consumptions. But imposing an increase in water prices may raise equity problem in the society and due to this fact policy makers rarely fully explore the underlying police aspect of change in water prices. Moreover, in order to achieve the target level of water consumption reduction, although some other non-pricing policy instrument such as rationing, subsidies for use of water-efficient technologies, restrictions on specific water consumptions and public information campaigns could be employed by policy makers, but in most of the cases water pricing systems are considered as the most effective tool to allocate water and influence water consumption pattern. The effectiveness of water pricing system has a positive correlation with the own-price elasticity of the water demand. So, we can say that high own-price elasticity of the demand this means that consumers are more sensitive to the changes in prices. In sum, the finding of reviewed studies suggests that the price elasticity of water demand tends to be insignificant. The minimum absolute value of the coefficients of price changes estimated in Strand and Walker (2005), Espiñeira and Nauges (2004), Espiñeira (2000), Pint (1999) and Renwick et al. (1998) is approximately 0.1, which means that a 10% increase in water prices will reduce water consumption by only 1% indicating that price changes is not an efficient policy to deduct water usage and other non-price policies could be more effective.

On the other hand, some other articles estimated greater values for own-price elasticity of the demand which are statistically significant. In particular, the coefficient of price changes estimated by Pint (1999) is -1.24, and price elasticity of water demand estimated by Mazzanti and Montini (2006) is -1.33, and thus residential water demand is estimated to be highly sensitive to percentage changes in water prices.

Based on the presented evidences by most of the reviewed articles generally the own-price elasticity of water demand is not important but the results of observations in some other studies contradicted this result by proving the existence of higher responsiveness of water consumers to alterations in water prices, and therefor concluding that price change could be an effective policy tool in water consumption reduction. This contrast could be justified by looking precisely at the price ranges in the employed data. Scrutinizing the data reveals that the own-price elasticity of the water demand is more likely to be higher and significant when water price range is considerably high. In a sense it can be concluded that, the own-price elasticity of the demand appears to depend on water price levels; in the cases in which water price range is narrow, the residential water demand tends to be inelastic, while in the opposite cases when the water price range is higher, the own-price elasticity of the demand will be significantly higher meaning that water consumers are highly responsive to water price changes. The existence of dependency of own-price elasticity of residential water demand on water price range is argued and confirmed by Cumming et al. (2005). This study came to the conclusion that for the marginal price of water greater than $2.33 in January and greater than $4.00 in July the residential water demand becomes elastic and sensitive to changes in water prices. But this subject deserves further investigation of the impacts of greater allowable changes in water price.

Introducing an efficient and effective water pricing policy requires the investigation of the relationship between water price range and own-price elasticity of residential water demand. Most of the articles reviewed in the literature section estimated residential water demand using the data collected from consumers that are subject to one of two-part tariff water pricing schedule, block-rate water pricing scheme and a combination of them which is called multi-tariff pricing scheme. Under two-part tariff water pricing schedule consumers pay fixed fee plus variable fee, where the designated fixed fee is mainly because of recovering investments in water supply infrastructures and dealing with equity problems, and variable fees depend on water consumption level. Under two-part tariff water pricing scheme variable fee is constant, whereas under multi-part tariff pricing schedule is not constant and varies from block to block. On the other hand, under block-rate scheme fixed fee does not exists and it consists of only variable fee and depending on pattern of variable fee to be decreasing, increasing or constant across consumption blocks, the block-rate water pricing scheme is respectively called decreasing, increasing or uniform block-rate water pricing scheme.

Impacts of water-pricing scheme on residential water consumption are different depending on water demand’s own-price elasticity at different usage levels. For example, if own-price elasticity of the water demand is increasing as the water consumption level increase, a smaller price increase is required to induce water consumers to take water-conserving action. In this case the increasing block-rate water pricing schedule is more consistent and appropriate than other pricing schemes and the dependency of water price on demanded quantity of water could be better reflected in increasing block-rate water pricing scheme. Based on the findings of most of the reviewed studies, it can be concluded that an increasing block-rate schedule is an effective way to induce consumers to reduce their water. Moreover, according to Taylor et al.(2004) in reducing water consumption level the performance of increasing block-rate schedule is even better than non-metered fixed monthly fees schedule and decreasing block-rate water pricing scheme. On the other hand, although the increasing block-rate pricing schedule has proved to be more effective, we need to take in to account the equity concerns. As discussed in the literature review, water has no close substitutes for the consumption levels that are less than minimum threshold which is required to fulfill only basic needs such as cooking, drinking and personal hygiene; once this level of consumption is satisfied additional unit of water consumption could be substituted. But if policy makers decide to reduce water consumption level by choosing increasing block-rate pricing schedule, equity problem may arise when households with low level of income may not afford water-conserving technologies while households with relatively higher income level do. To avoid such equity concern policy makers could offer subsidies to low-income households for using water-efficient technologies. As a matter of fact equity concern is not the only impediment in implementing increasing block-rate water policy, but also since water is vitally crucial commodity, generally policy makers cannot increase water price by any desired magnitude, and thus water price remains at lower level and this may lead to over-consumption or misuse of water by consumers. Given the essential nature of water, addressing the equity and affordability problems is particularly relevant, but based on suggestions of OECD (2003), equity and affordability problems may not be addressed by paying subsidies for water services, and accordingly keeping water prices at the levels which are lower than the marginal social cost of water supply. Although water prices must be determined in an efficient way that reflect all water provision costs and prevent any possible misleading and provide water consumers an appropriate signal in making decisions on water consumption, simultaneously should ensure grounds for assisting low-income households. One of the possible solutions to this contrast is setting a minimum allowable level of water consumption with free or lower price to ensure that low-income households' basic needs such as personal hygiene, drinking and cooking are satisfied. For the consumptions below this minimum level, households' water demand would be inelastic and thus pricing schedules would not be effective in inducing households to reduce their water consumption and significant welfare implications would be present. While some studies estimated the minimum amount of water to be monthly 2.6 cubic meters per person, a level that satisfies basic needs but the determination of such a minimum level is still ambiguous and more investigation is required to determine if historical water consumption levels and factors such as permanent characteristics of the environment should be taken in to account. One of the first challenges of policy makers is that they should understand consumers' behavior comprehensively in a comparative framework of analysis and this is prerequisite to be able to identify all crucial factors in estimating the minimum water consumption level that satisfies basic needs. Some water related studies suggested that to eliminate overuse and misuse of water by households such as free or low-priced minimum allowable level should be determined in a lowest possible level which is required by households to satisfy only their basic needs. On the other hand, households' water demand for water consumption levels greater than the minimum free or low-priced level turns to be price-sensitive, water pricing schedule could be used to reduce water consumption but this may resulted in inequality problems. In order to mitigate inequalities that could arise from implementing pricing policy, the pricing system should be equipped by supplementary schedules. In addition, better understanding the impacts of income on different households' decision on water consumption is required to construct an appropriate policy program consisting of both pricing mechanism and supplementary programs to effectively reduce water consumption level. Households are different from each other in terms of their responsiveness to changes in water prices, which in turn is dependent on their observable socio-economic and socio-demographic characteristics. Almost all of the reviewed empirical studies uniformly suggested that income is a crucial factor in affecting households' decision on water consumption and it has considerably significant impacts on residential water consumption demand. The estimated income elasticities of water demand vary from 0.1 to 0.71. Residential households with relatively higher level of income are comparatively expected to consume more water, because they mostly use water consuming fixtures and facilities like washing machines, dishwashers, and swimming pools. A comprehensive grasp of the origins of the existing differences between households with low-income level and those with high income level could be helpful in designing policy mechanism to restrict water consumption in a more efficient way. Moreover, explanation of the impacts of income on own-price elasticity of the water consumption demand warrants more investigation. In addition to income, there are some other potential factors such as family size, age, house characteristics and other socio-demographic characteristics that may affect the own-price elasticity of the water demand, but existence of the contrast between present findings of different studies prevents to have a definite conclusion about their impacts. However, available studies provided some evidences about the price sensitivity of the residential households. Based on these evidences, for instance, older consumers, households who are living in high-density regions and multistory buildings' residences are found to consume less water, but estimating their degree of price-sensitivity deserves more investigation.

As a whole consideration, to achieve the goal of water consumption reduction by households, although water pricing mechanism as an effective policy tool gathered sum supports but, the possibility of differences between price-sensitivity of the different residential households weakened the presumed effectiveness of pricing policy instruments and policy makers should scrutinize the own-price elasticity of the water demand across households deliberately. Furthermore, the answer for question that how is the shape of an optimal pricing schedule and how to design it is still ambiguous and also it is not clear that to mitigate inequality problem that may arise from implementing pricing schemes, which non-pricing measures should be supplemented to pricing instruments, provided that there exist differences between households in terms of their responses to changes in water prices.

Moreover, effectiveness of any policy measure to induce water consumption reduction requires residential households to be perfectly informed about the policy scheme. For example, Gaudin (2006), Strand and Walker (2005), Taylor et al. (2004), Nauges and Thomas (2000), Nieswiadomy (1992), Chicoine and Ramamurthy (1986), found that consumers are less likely to totally understand the structure of pricing system and thus the marginal prices that are assigned for different blocks of water consumption when they are subject to block-rate water pricing scheme. Gaudin (2006), showed that providing information about marginal price of water adjacent to water consumption level that is written on water bill, enhanced the price-sensitivity of the consumers and accordingly the price elasticity of water demand increased from -0.37 to -0.51. More interestingly, the study concluded that if the information about marginal price of the water provided properly on the bill, for a given amount of water consumption reduction, water price could be increased by 30% less, assuming that the price elasticity of the water demand remains constant. To enhance the effectiveness of policy program introducing single metering scheme could be worthwhile, because under single metering schedule consumers could observe the differences in water prices. Various studies like Nauges and Thomas (2000), OECD (1999), Mid-Kent (1997), Herrington (1997) and Edwards (1996), came to the end that in the presence of single metering mechanism and thus having information about water price, consumers will reduce their consumption considerably and their estimations for the amount of reductions vary from 7% to 35%.

In addition to pricing policy measures, the impacts of some other non-price policy tools such as public information campaigns, subsidizing adaptation of water-conserving technologies, subsidizing the use of low-flow showerheads and other water-conserving equipment such as low-flow toilets (or distributing them freely), restrictions on specific water consumptions (e.g. banning irrigation of landscape in the peak period), rationing water services, compulsory water-conserving systems have been discussed previously. Among all these policy tools, in the short run, particularly in the presence of severe drought when immediate and substantial reduction in water consumption is needed, restrictive policy tools such as rationing and restrictions on specific water consumptions tend to have greater impact on residential households and reduce water use in a more effective way than other policy tools like public information campaigns that encourage consumers to voluntarily reduce their water consumption. Beside this, some studies showed that restrictive policy tools are even more effective than water pricing instruments. For instance Espiñeira and Nauges (2004) found that only daily interruption of water service reduces residential water consumption with an amount that would be achieved by 9% increase in water price. Renwick et al. (1998) figured out that restrictive measures reduced water consumption by more than 15% suggesting that restrictive tools are more effective than pricing measures in reducing water consumption. But taking in to account the welfare losses that may be imposed by implementation of each policy measure, there is still some room to investigate that which one of them is more effective. Furthermore, the study by Woo (1994), suggested that water pricing policy instrument is considerably more efficient than restrictive policy measures in reducing water consumption in terms of welfare loss. Therefore, except from urgent cases in which an immediate reduction in water consumption is required (e.g. severe droughts) where water restriction policies could be supplemented to pricing measures, in general , taking in to account welfare implications, water restrictions are not appropriate alternatives to pricing measures. Nauges and Thomas (2003) and Dandy et al. (1997) figured out that water consumers do not respond immediately to water pricing policy and thus post-policy water reductions occurs later, because making decision on water consumption is time consuming (e.g. it takes time to substitute water-using durables such as washing machines, dishwashers and etc.). Based on findings of Renwick and Archibald (1998), encouraging water consumers to set up water-conserving equipments thorough free allocation of low-flow showerheads and offering rebates on water-conserving toilet systems as a non-price policy measures will reduce residential water consumption[8]. In addition, various studies pointed out the positive relationship between residential water consumption and owning landscapes and lawns. The studied data revealed that low-density regions own most of the water-consuming landscapes and thus density has impacts on residential water demand. Finally they suggested that restrictions on landscape irrigations could significantly affect the residential water consumption in low-density regions. Furthermore, landscape design and thus the choice of landscape is a determinant factor of residential water consumption demand. This is confirmed by findings of Hurd (2006) and Domene and Sauri (2005), they suggested that planting water-conserving turf grasses rather than traditional water-consuming turfs could reduce residential water consumption substantially. Therefore voluntary measures (e.g. public information campaign) can be adopted by policy makers to enhance residential customers' knowledge about water-consuming turf grasses and reduce water use accordingly.

[8] - they estimated 8% reduction in water consumption resulted from adoption of low-flow showerheads and 10% reduction thorough installing low-flow toilets.

Chapter 3

3. The empirical analysis

3.1 The dataset

The empirical analysis is based on the data of a survey that was carried out in March 2012. based on the request of European Commission's Directorate-general for the environment the survey "Flash Eurobarometer 344" was conducted by "TNS political &Social". The Flash Eurobarometer 344 covers the population of 25,524 individuals from different nationalities of the European Union member states. All respondents of the survey are citizens of EU27 member states and all of them aged 15 years and over and their age averaged by 50.02. To carry out the survey, TNS e-call center called the respondents by both landline and mobile phone and in each household the respondent was selected on the basis of "last birthday rule". The primary purpose of the survey was to gauge the awareness of the respondents regarding water quantity and quality problems in their country and to investigate attitudes of Europeans towards water related issues. The survey examined the EU27 citizens' answers about:

- whether they felt informed about problems that were facing rivers, groundwater, lakes and coastal waters.
- significance of water problems and perceived alterations in the quality of groundwater, rivers, lakes and coastal waters;
- the impact of different sectors such as households, agriculture, tourism, energy plants and transportation on water status in terms of quality and quantity;
- The main threats to the water environment;
- The price of water;
- Actions to preserve water and decrease water pollution and consumption (by individuals and/or by EU);
- EU's policy measures and awareness of the blueprint to preserve Europe's water resources;

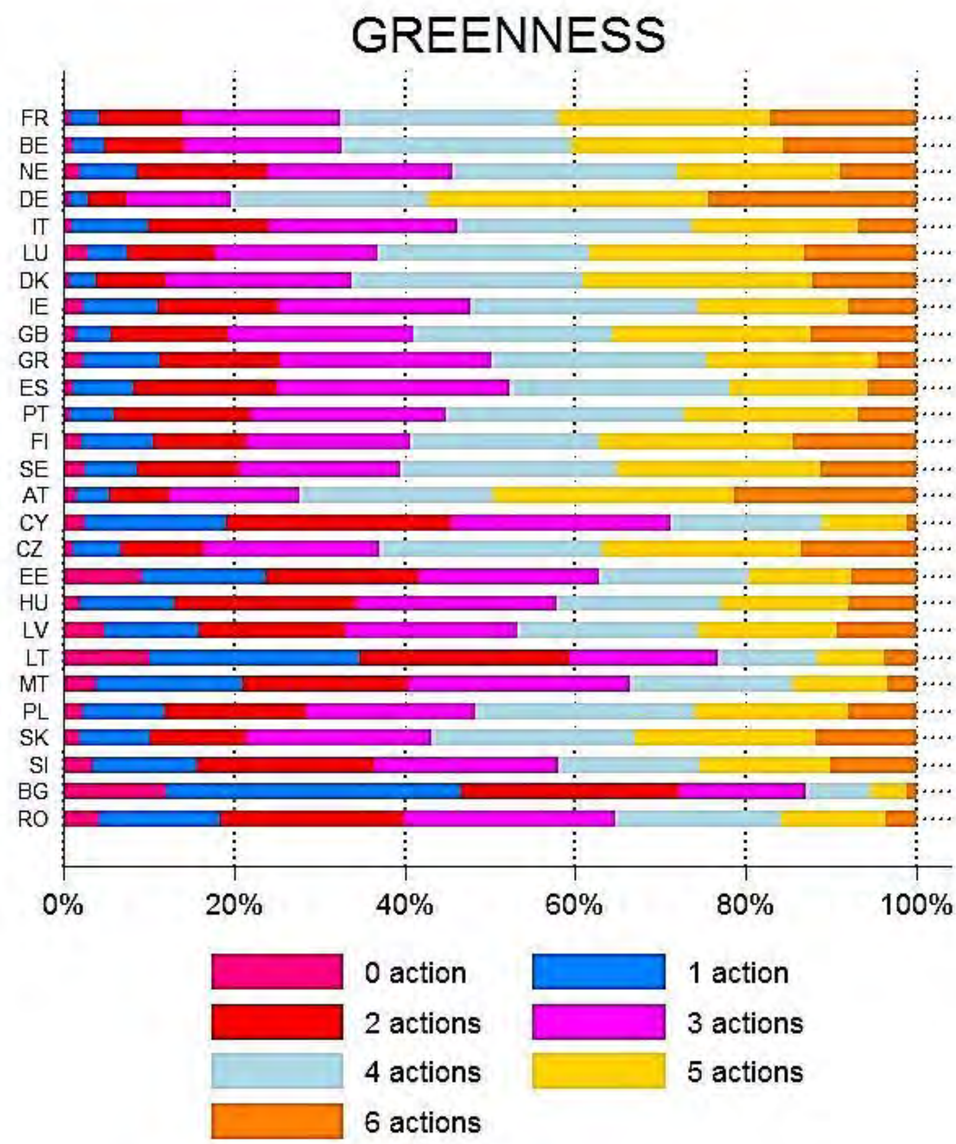
- level of knowledge about river basin management plans and involvement in consultation steps.

Finally the information about some socio-demographic characteristics was collected consisting of respondent's age, gender, years of education and occupation. A descriptive analysis of the data revealed that many EU 27 citizens (61.03%) declared that they are not well-informed regarding problems facing rivers, coastal waters, lakes and groundwater. Moreover, more than 70% of respondents believe that water quality problem is serious in their country of the residence. While the majority of EU citizens have taken at least one action against water quality and quantity problem they believe that the water problem has not been addressed sufficiently and that dealing with water problems requires further actions. In the empirical part of the study I attempt to identify the main determinants of individuals' behavior in reducing water problem in Europe. The absence of data on income and price has eliminated the ability of investigating the impacts of these two main variables.

The variable of interest "GREENNESS", which is ordinal, is defined starting from responses to the question "There are different ways to reduce water problems and become more water efficient. In order to reduce these problems have you done any of the following in the last two years?", Limiting amounts of water used, using eco-friendly household chemicals, avoiding the use of pesticides and fertilizers in the garden, harvesting rain water, choosing organic farming products, recycling household oil waste, unused pharmaceuticals, unused household chemicals, paints, solvents and batteries. As different options are coded as binary variables, our dependent variable (labeled as "GREENNESS") is obtained on the basis of the number of positive answers to the question. Accordingly, the dependent variable takes values from 0 to 6 depending of number of actions the individual undertakes. Descriptive statistics shows that only 2.96% (756) of respondents did nothing to reduce water problems, whereas, 9.58% (2445) of individuals have committed only one action; 14.94% (3814) have taken two actions, 20.73% (5291) declared applying three of the actions, those who have implemented four actions comprise 22.59% (5765) of respondents, 19.16% (4890) of the respondents stand in the second place by implementing five actions, and finally those who declared the implementation of all six actions are

10.04% (2563) of the sample. Figure.1 depicts the distribution of dependent variable across EU27 countries.

Figure.1. Distribution of GREENNESS variable by country

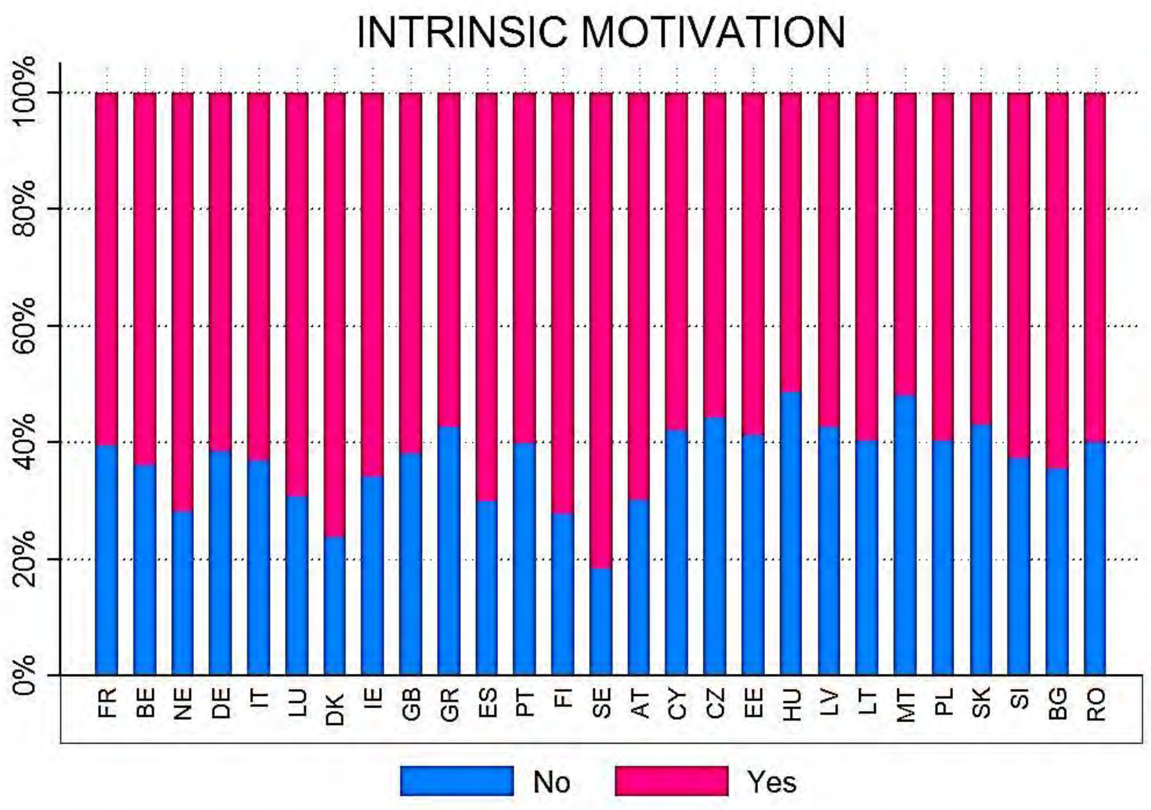


Source: based on Eurobarometer 344, calculated by author

Furthermore, with the aim of investigating impacts of included variables on six water related responses, I defined six dummies as dependent variables as follows: variable lim_water takes value 1 if an individual limited his/her water use by installing water-saving appliances, taking shower instead of bath and not leaving taps running etc, and zero otherwise. Dummy variable eco_chem takes value 1 if the respondent used eco-friendly household chemicals and 0 otherwise. Explanatory variable no_pest takes value 1 if individuals did not use fertilizers and pesticides in their garden and 0 otherwise. harv_rain variable takes value 1 if an individual declared that he or she harvested the rain during past two years and zero otherwise. Org_farm dummy takes value 1 if the respondents have chosen organic farming products and zero otherwise, and finally an explanatory variable rec_unused takes value 1 if an individual declares that he/she has recycled unused pharmaceuticals, oil waste, unused chemicals, solvents, paints and batteries, and zero otherwise. Descriptive statistics revealed that 80.48% (20,541) of respondents limited their water use, 54.06% (13,797) of the respondents used eco-friendly household chemicals, 60.20% (15,365) did not use fertilizers and pesticides in their garden, 38.62% (9,857) harvested rain water, 45.86% (11,705) have chosen organic farming products, and finally, 68.83% (17,569) of the respondents have recycled their unused pharmaceuticals, paints, household chemicals and oil waste, solvents and batteries during last two years.

In the study of waste management by Cecere et al (2014), the dummy variable corresponding to intrinsic motivation captures individuals' preferences to pay taxes for quantity of the waste that their family generates. They assumed that those who do not prefer to pay taxes to cover waste management on the basis of quantity generated, are intrinsically motivated. Based on this definition, to measure the intrinsic motivations I defined an explanatory variable INTRINSIC_MOTIVE using the responses to question Q8 of the survey which is asks individuals if they "totally agree, tend to agree, tend to disagree or totally disagree with inclusion of environmental impacts of water use in prices, and thus water will be more expensive if its consumption has significant environmental impacts. The variable takes value "1" if respondents' choice is "Totally agree" or "Tend to agree' and it "0" if he/she declares "Tend to disagree" or "Totally disagree". This question is considered as a criterion to classify individuals as intrinsically motivated consumers; those who believe that environmental impacts must be reflected in water price are assumed as self-motivated consumers who are internally concern about status of the environment and thus are willing to pay more for negative impacts that may arise from their consumption.
Figure.2 depicts the distribution of this variable across EU27 countries.

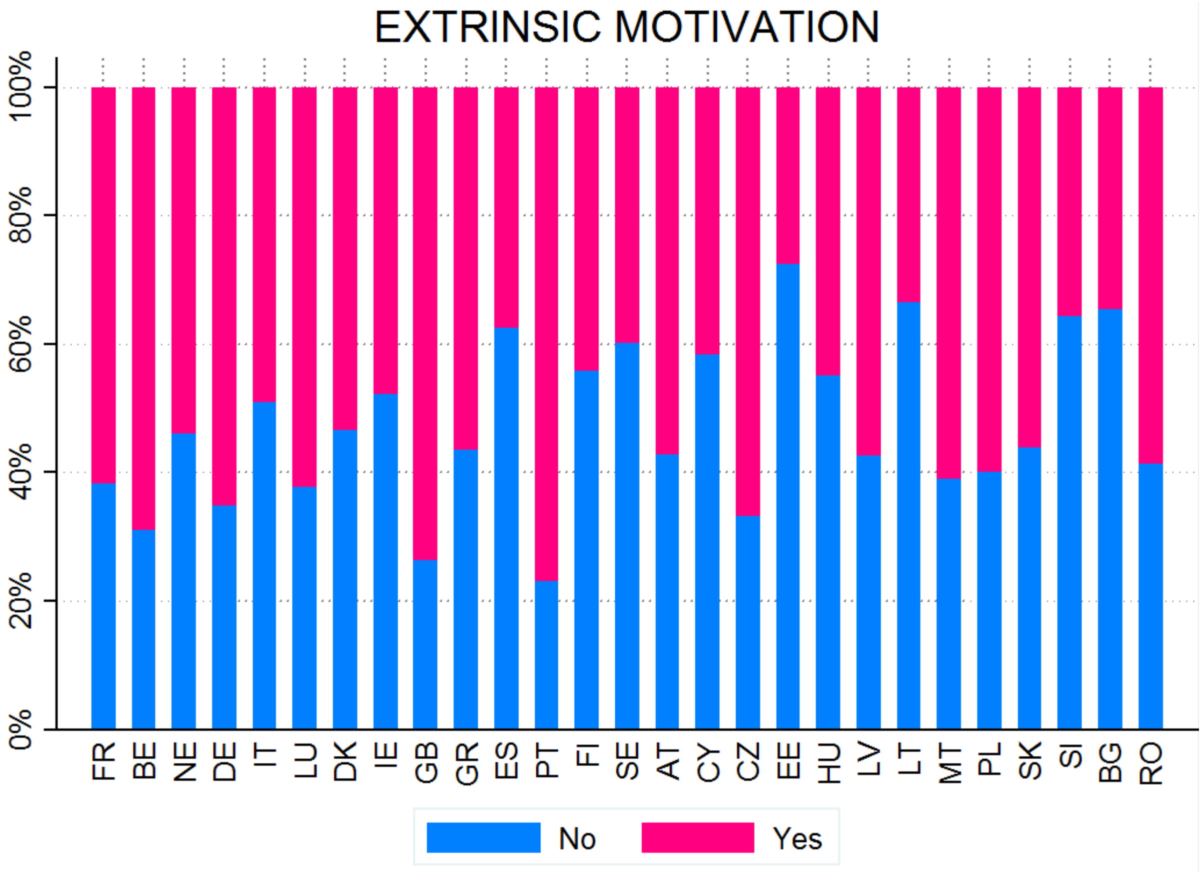
Figure.2. Country specific distribution of variable "INTRINSIC_MOTIVE"



Source: based on Eurobarometer 344, calculated by author

In order to measure extrinsic motivations that may have impacts on individuals behavior in reducing water problem, I included a dummy variable EXTRINSIC_MOTIVE which takes the value one if an individual declares that ensuring higher financial incentives (e.g. tax breaks, subsidies) for efficient water use is a most effective way in tackling water problem (based on Q10 in the survey which asks about individuals' opinion about most effective ways of tackling water problems) and zero otherwise. In defining this variable I assumed that those who believe that financial incentives can be considered as an effective tool to reduce water problems are not self-motivated and need external rewards to commit environmental-friendly actions. Figure.3 depicts the distribution of this variable across EU27 countries.

Figure.3. Country specific distribution of variable “EXTRINSIC_MOTIVE”



Source: based on Eurobarometer 344, calculated by author

Furthermore, to examine the impacts of possession of specific knowledge regarding water problems in the country of residence, I included a dummy variable SPECIFIC_KNOWLEDGE based on responses to Q1 of the survey which asks about individuals’ knowledge regarding problems facing groundwater, lakes, rivers and coastal waters in respondents’ country of residence. This variable takes value one if an individual declares that he/she is well informed about problems facing water and zero otherwise. There are other potential variables such as awareness about quality and awareness about quantity and knowledge about policy that may affect consumers’ behavior toward water related issues. In order to investigate their impacts the explanatory variables AWARENESS_QUALITY, AWARENESS_QUANTITY are defined using the responses to Q2 of the survey which asks about the seriousness of the water quality and quantity problems. POLICY_KNOLEDGE_A is constructed using the responses to question Q12 of the survey which asks individual whether they are informed about EU's plan to analyze the current EU water policy in order to publish a new Strategy by end of the year 2012. Moreover, POLICY_KNOWLEDGE_B is constructed based on Q14 of the survey which asks about respondents' knowledge about River Basin Management Plans. This dummy takes value 1 if an individual's declares he/she is informed and 0 otherwise. Another potential variable which captures respondent's consciousness about impacts of water consumption is defined using the responses to question Q4 of the survey. The variable takes value one if individuals' choice is "a large impact" or "a moderate impact" and zero if his/her choice is either "a little impact" or "no impact at all". Finally, the existence of significant relationships between water consumption behavior and some socio-demographic characteristics such as age, years of education, occupation, types of living districts and geographical dummies are explored (Descriptive statistics of the variables are presented in Annexes, Table.1).

3.2 Estimation and Main findings

The results are presented in Annexes, Table.2 and Table.3. In the first part of the empirical study, I explored the impacts of potential independent variables on various water related responses using logistic regression model and results are shown in Table.2 by six different specifications. Estimated impacts of independent dummies on variables lim_water, eco_chem, no_pest, harv_rain, org_farm, and rec_unused are shown in specifications (1) to (6) respectively (the definitions of dependent variables are presented in Table.1). Results revealed that extrinsic motivation affects all six responses significantly and in a positive way, and the highest coefficient belongs to specification (1), which is 0.4842, meaning that the probability of limiting water use by extrinsically motivated individuals is 48.42%. All of the estimated coefficients for intrinsic motivation are significant and among six responses, intrinsically motivated individuals use organic farming products with highest probability (24.70%). Moreover, while all other estimated coefficients for intrinsic motive are significant with 99% confidence interval, only its impact on harvesting rain water is significant with 90% confidence interval. While being informed about EU's new water strategy affects only "harv_rain" significantly and has positive impacts on individuals' harvesting rain water response, all estimated coefficients for knowledge about River basin management plan have positive sign and are statistically significant. The impacts of variable corresponding to awareness about water quality problems on "harv_rain" and "rec_unused" are insignificant, but its impacts on other four responses are positive and significant. Moreover, awareness about quantity problems of water is irrelevant only in affecting individuals to recycle unused harmful materials. Having specific knowledge about water problems has positive and significant impacts on all six responses. Furthermore, while being conscious about impacts of water consumption is irrelevant in affecting both "harv_rain" and "rec_unused", it has significant impact on other four responses and its coefficients have positive sign. Consistent with expectations Male dummy affects all responses negatively. Based on the estimated coefficients for Age dummies it can be concluded that the probability of limiting water use, harvesting rain water and using organic farm products increases by age, but those who aged from 40 to 54, undertake other three actions with higher probability. There are no significant differences between the impacts of living in small town or in large city on all responses. Regarding occupation status, results shows that although self-employed individuals and employees are more responsive, but surprisingly, the estimated coefficients for "Selfemployed" and "Employee" dummies are negative and significant in limiting water use and harvesting rain water, respectively. Education status dummies are irrelevant in limiting water use, but students do not use pesticides and fertilizers, and harvest rainwater with higher probability. On the other hand, those who have university degrees use ecofriendly chemicals, choose organic farm products and recycle environmentally harmful unused materials with higher probability. Regarding macro region dummies, it can be concluded that southern Europeans limit their water use with higher probability, possibly because drought is more serious in southern countries and their citizens perceived the seriousness of the problem. Except from limiting water use, the results show that western Europeans undertake all other 5 actions with higher probability compared with other regions.

The Since the dependent variable GREENNESS is ordinal, I used the Ordered Logistic Regression model to examine whether the included variables have statistically significant impacts on EU27 citizens' behavior in reducing problems facing water (regarding both quantity and quality). In order to test the robustness of the estimations I included four different specifications in Table.3: with the aim of gauging solely the impacts of extrinsic motivation, EXTRINSIC_MOTIVE and socio-demographic variables are included in specification (i). Specification (ii) estimates effects of INTRINSIC_MOTIVE on individuals' water consumption behavior together with extrinsic motivation. Specification (iii) takes in to account other explanatory variables such as policy knowledge, awareness about problems facing water regarding quality and quantity and geographical dummies. Finally, countries' fixed effects are involved in specification (iv). Table.4 indicates marginal effects which are computed with respect to regression (ii).

The results of the estimations support the presumed expectations. All four specified estimations revealed that the included variables corresponding to extrinsic motivation, intrinsic motivation, specific knowledge about water problems, awareness about water problems regarding quality, awareness about water problems regarding quantity (e.g. water droughts), consciousness about impacts of water consumption and some socio-demographic variables are all relevant and have statistically significant impacts on individual's water consumption behavior. On the other hand, an explanatory variable corresponding to knowledge about EU's new water policy is irrelevant. In addition, "Elementary" dummy is not significant in all specifications whereas, "Secondary" and "University" variables are insignificant in three of them (to know the definition of each variable please refer to Annexes, Table.1).

In general, the findings show the existence of the meaningful relationship between extrinsic motivation and individuals' water consumption behavior in all regressions. Estimated coefficients have positive signs and more precisely, based on specification (iv), the likelihood of taking one more action to reduce water problem and accordingly being in higher category is approximately 56.52%, meaning that ensuring higher financial incentives by policy makers could affect individuals' water consumption behavior significantly.

In addition to extrinsic motivation, consistent with expectations, intrinsic motivation is also playing an important role in inducing water consumers to reduce water problems. As presented in specification (iv), also INTRINSIC_MOTIVE plays an important role in individuals decision making, and it has significant positive impacts. The probability of taking one more action and thus being in higher category is 26.24%, suggesting that fostering intrinsic motivation could be employed as a complementary policy measure in reducing water problems especially when other measures are not efficient. Also having knowledge about River Basin Management Plan (RBMPs are policy instruments to improve water across Europe) encourages water consumers' environmental-friendly behaviors significantly and in a positive way. Moreover, the estimations revealed that on one side, awareness about problems facing quality of the water could induce households to take more action to preserve water. As shown in Table.3, variable AWARENESS_QUALITY has positive sign and significant impact on water consumption behavior, on the other side results showed that awareness about problems facing quantity of the water (e.g. severe droughts and overconsumption) affects individual's behavior significantly and in a positive way, in particular if the dummy is equal to one the probability of taking one more action and being in higher category is 23.74%. In addition to these two variables, having specific knowledge about water problems (e.g. being informed about problems facing groundwater, lakes, rivers, and coastal waters) and being conscious about the impacts of water consumption and waste water (captured by CONSCIOUSNESS dummy) tend to have positive impacts on individuals' water consumption behaviors and thus all four estimations support the effectiveness of public information campaigns in reducing water problems. Concerning the included socio-demographic factors that are commonly used by empirical studies, the results supported the expectations with respect to education level. The estimations revealed that number of years of education has positive impacts on reducing water problems. In other words, the higher the education level the higher will be the likelihood of taking more action to reduce water problem and thus being in higher category. Furthermore, based on the estimations with respect to age ranges it can be concluded that except from specifications (iv) the probability of committing one more action to reduce water problem increases by age and those whose age is 55 and over are more likely to take additional action than other different age groups. Moreover being male affects water-preserving behavior significantly but in a negative way. With respect to occupational status, the results revealed that self-employed and employees are more likely to take more actions against water problem. And finally inclusion of EU macro region dummies revealed that Western European citizens are more likely to take more actions and be in a higher category of greenness whereas Northern Europeans stand in a second place.

The marginal effects are computed by setting the variables to their mean value and based on the regression with specification (ii) and the results are presented in Table.4. The lowest level of probability is associated with outcome 0 meaning that the probability of taking no action against water problem and thus being in the lowest category is 2.37% provided that variables are set at their mean values. The highest value of the probability is associated with outcome 4, meaning that at the mean value of the explanatory variables, the probability of taking 4 actions to reduce water problem is approximately 24.21%.

4. Conclusions

In this study I investigated the impacts of main determinant factors on individuals' water consumption behavior. At first, in the literature review section, I presented some evidences from different water related articles then in the following sections the policy and welfare implications of various policy tools were investigated. Most of the studies provided some common results in estimating the impacts of several price and non-price determinant factors on water consumption demand. Among them the most important determinant of water consumption demand is price change. If the own-price elasticity of the demand is statistically significant then water price change could be employed as an effective policy measure to induce consumers to reduce their consumptions. Water pricing system my sought by inequality problems and impose burden only on low income households and thus policy makers must scrutinize the consequences of water pricing policy. Moreover, in order to achieve the target level of water consumption reduction, although some other non-pricing policy instrument such as rationing, subsidies for use of water-efficient technologies, restrictions on specific water consumptions and public information campaigns could be employed by policy makers, but in most of the cases water pricing systems are considered as the most effective tool to better allocate water and influence water consumption pattern. But in general, the findings of the reviewed studies showed that the price elasticity of water demand tends to be insignificant suggesting that pricing policies may not be employed as an efficient tool. On the other hand, own-price elasticity of the water demand is more likely to be higher and significant when water price range is considerably high. In other words the own-price elasticity of the demand seems to be dependent on water price levels, therefore, introducing an efficient and effective water pricing policy requires the investigation of the relationship between water price range and own-price elasticity of residential water demand.

Furthermore, Depending on own-price elasticity of water demand at different consumption level, the impacts of water-pricing scheme on residential water consumption could vary significantly. For example, if own-price elasticity of the water demand is increasing as the water consumption level increases, and thus smaller price increase is required to induce water consumers to take water-conserving action. If this is the case the increasing block-rate water pricing schedule is more consistent and appropriate than other pricing schemes and the dependency of water price on demanded quantity of water could be better reflected in increasing block-rate water pricing scheme but still equity consequences must be explored. To avoid such equity concern, policy makers could offer subsidies to low-income households for using water-efficient technologies. But given the essential nature of water, addressing the equity and affordability problems is particularly relevant, but based on suggestions of OECD (2003), equity and affordability problems may not be addressed by paying subsidies for water services, and accordingly keeping water prices at the levels which are lower than the marginal social cost of water supply. Although water prices must be determined in an efficient way that reflect all water provision costs and prevent any possible misleading and provide water consumers an appropriate signal in making decisions on water consumption, simultaneously should ensure grounds for assisting low-income households. Although assigning minimum free level of consumption is the potential solution to equity problems but the determination of such a minimum level is still not clear and more investigation is required. In order to mitigate inequalities that may arise from implementing pricing policy, the pricing system should be equipped by supplementary schedules. Households are different from each other in terms of their responsiveness to changes in water prices, which in turn is dependent on their observable socio-economic and socio-demographic characteristics. As a whole consideration, to achieve the goal of water consumption reduction by households, although water pricing mechanism as an effective policy tool gathered some supports but, the possibility of differences between price-sensitivity of the different residential households weakened the presumed effectiveness of pricing policy instruments and policy makers should scrutinize the own-price elasticity of the water demand across households deliberately. Furthermore, the answer for question that how is the shape of an optimal pricing schedule and how to design it is still ambiguous and also it is not clear that to mitigate inequality problem that may arise from implementing pricing schemes, which non-pricing measures should be supplemented to pricing instruments, provided that there exist differences between households in terms of their responses to changes in water prices. Another fact to be kept in mind is that effectiveness of any policy measure to induce water consumption reduction requires residential households to be perfectly informed about the policy scheme.

Among all pricing and non-pricing policy tools, in the short run, particularly in the presence of severe drought when immediate and substantial reduction in water consumption is needed, restrictive policy tools such as rationing and restrictions on specific water consumptions tend to have greater impact on residential households and reduce water use in a more effective way than other policy tools like public information campaigns that encourage consumers to voluntarily reduce their water consumption. Beside this, some studies showed that restrictive policy tools are even more effective than water pricing instruments, but Woo (1994) showed that the welfare losses associated with various restrictive policies are extremely large in comparison with pricing policy measures, suggesting that water pricing policy instrument is considerably more efficient than restrictive policy measures in reducing water consumption. Therefore, except from urgent cases in which an immediate reduction in water consumption is required (e.g. severe droughts) where water restriction policies could be supplemented to pricing measures, in general , considering welfare implications, suggests that water restrictions are not appropriate alternatives to pricing measures. In the empirical study, due to lack of data on water price and individual's income I mainly focused on non-price factors. In the presence of drawbacks of different water pricing and non-pricing system, concentrating on promoting intrinsic values and thus designing water policies which includes measures to encourage households environmental morale could have substantial impacts on households water consumption behavior both in short and long term. As found by the empirical study, in addition to extrinsic motivation, intrinsic incentives, individuals’ consciousness about consequences of water consumption, awareness about water quality and quantity problems and finally being informed about implemented water policy have significant impacts on individuals behavior and thus designing policies to promote each of them could lead to substantial reduction in problems facing both quality and quantity of the water.

References

Agthe, D. E., B. R. Billings, J. L. Dobra and K. Raffiee (1986), ―A Simultaneous equation Demand Model for Block Rates", Water Resources Research, 22(1), 1-4.

Berk, R. A., T. F. Cooley, C. J. LaCivita, S. Parker, K. Sredl and M. Brewer (1980), ―Reducing Consumption in Periods of Acute Scarcity: The Case of Water", Social Science Research, 9(2), 99-120.

Baumol, W. J., & Oates, W. E. (1979). Economics, environmental poiicy. and the quality of life. Englewood Cliffs, NJ: Prentice-Hall.

Billings, R. B. (1987), ―Alternative Demand Model Estimators for Block Rate Pricing", Water Resources Bulletin, 23(2), 341-345.

Billings, R. B. and D. E. Agthe (1980), ―Price Elasticites for Water: A Case of Increasing Block Rates", Land Economics, 56 (February), 73-84.

Brookshire, D. S., H. S. Burness, J. M. Chermak and K. Krause (2002), ―Western Urban Water Demand", Natural Resources Journal, 42(4), 873-989.

Bruno S. Frey (1999), ―Morality and Rationality in Environmental Policy", Journal of Consumer Policy 22: 395-417.

Cameron, J. & Pierce, W. D. (1994). ―Reinforcement, reward, and intrinsic motivation: A meta-analysis". Review of Educational Research, 64, 363-423

Chicoine, D. L. and G. Ramamurthy (1986), ―Evidence on the Specification of Price in the Study of Domestic Water Demand", Land Economics, 62 (February), 26-32.

Creedy, J., J. van de Ven and Kirsty E. McKenzie (1998), ―The Demand for Water by Single-metered and Group-metered Households", Australian Economic Review, 31(3), 203-210.

Cummings, R., J. Hill, B. Thompson and D. Wilson (2005), ―Conservation Pricing of Household Water Use in Public Water Systems in Georgia's Coastal Communities: A Preliminary Exploration", Working Paper # 2005-007.

Dalhuisen, J. M. (2003), ―Price and Income Elasticities of Residential Water Demand: A Meta-analysis", Land Economics, 79(2), 292-308.

Dandy, G., T. Nguyen and C. Davies (1997), ―Estimating Residential Water Demand in the Presence of Free Allowances", Land Economics, 73(1), 125-139.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). Extrinsic rewards and intrinsic motivation: A clear and consistent picture after all. Psychological Bulletin.

Domene, E., and D. Sauri (2005), ―Urbanisation and Water Consumption: Influencing Factors in the Metropolitan Region of Barcelona", Urban Studies, 43(9), 1605-1623.

Edwards, K. (1996), ―The Role of Leakage Control and Metering in Effective Demand Management", paper delivered at Conference on Water 96: Investing in the Future, London.

Eisenberger, R., & Cameron, J. (1996). Detrimental effects of reward. Reality or myth? American Psychologist, 51, 1153—1166

Espey, M., J. Espey and W. D. Shaw (1997), ―Price Elasticity of Residential Demand for Water: A Meta-Analysis", Water Resources Research, 33(6), 1369-74.

Espiñeira, R. Martfnez (2000), ―Residential Water Demand in the Northwest of Spain", Environment Department, University of York, UK.

Espiñeira, R. Martínez and C. Nauges (2004), ―Is All Domestic Water Consumption Sensitive to Price Control?", Applied Economics, 36(15), 1697-1703.

Frey, B. S. (1997a). Not just for the money. An economic theory of personal motivation. Cheltenham, UK: Edward Elgar.

Frey, B., Jegen, R., 2001. Motivation crowding theory. Journal of Economic Surveys 15 (5),589–611.

Grazia Cecere, Susanna Mancinelli, Massimiliano Mazzanti (2014), ―Waste prevention and social preferences: the role of intrinsic and extrinsic motivations", Ecological Economics 107 (2014) 163–176

Gaudin, S. (2006), ―Effect of Price Information on Residential Water Demand", Applied Economics, 38(4), 383-393.

GESIS Data Catalogue, ZA5779: Flash Eurobarometer 344 ―Attitudes of Europeans Towards Water–related Issues" https://dbk.gesis.org/dbksearch/SDesc2.asp?ll=10&notabs=&af=&nf=&search=&search2=&db=E&no=5779

Gilg, A. and S. Barr (2005), ―Behavioral Attitudes Towards Water Saving? Evidence from a Study of Environmental Actions", Ecological Economics, 57, 400-414.

Gneezy, U., Rustichini, A., 2000. Pay enough or don't pay at all. Quarterly Journal of Economics 115 (3), 791–810.

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. Strategic Management Journal, 17 (Winter Special Issue), 109-122

Griffin, R. C. and C. Chang (1990), ―Pretest Analyses of Water Demand in Thirty Communities", Water Resources Research, 26(10), 2251-55.

Headley, J. Ch. (1963), ―The Relation of Family Income and Use of Water for Residential and Commercial Purposes in the San Francisco-Oakland Metropolitan Area", Land Economics, 39(4) (November), 441-449.

Hensher, D., N. Shore and K. Train (2005), ―Households' Willingness to Pay for Water Service Attributes", Environmental and Resource Economics, 32(4), 509-531.

Henson, S. (1984), ―Elasticity Demand Estimates under Increasing Block Rates", Southern Economic Journal, 51 (July), 147-56.

Herrington, P. R. (1997), ―Pricing Water Properly", in O'Riordan, Ecotaxation, Earthscan, London.

Howe, Ch. W. and F. P. Linaweaver Jr. (1967), ―The Impact of Price on Residential Water Demand and Its Relation to System Design and Price Structure", Water Resources Research, 3(1), 13-31.

Hurd, H. B. (2006), ―Water Conservation and Residential Landscapes: Household Preferences, Household Choices", Journal of Agricultural and Resource Economics, 31(2), 173-192.

Jones, C. V. and John Morris (1984), ―Instrumental Price Estimates of Residential Water Demand", Water Resources Research, 20(2), 197-202.

Khan, J.R (2005), The Economic Approach to Environmental and Natural Resources, (Thomson South-Western, third edition, U.S.A.).

Krause, K., J. M. Chermak, and David S. Brookshire (2003), ―The Demand for Water: Consumer Response to Scarcity", Journal of Regulatory Economics, 23(2), 167-191.

Mazzanti, M. and A. Montini (2006), ―The Determinants of Residential Water Demand: Empirical Evidence for a Panel of Italian Municipalities", Applied Economics Letters, 13(2), 107-111.

Mid-Kent (1997), ―Meter Pilot Project Report 1", Mid-Kent Water Plc., Snodland, UK.

Moncur, J. (1987), ―Urban Water Pricing and Drought Management", Water Resources Research, 23(3), 393-398.

Nauges, C.and A. Thomas (2003), ―Long-run Study of Residential Water Consumption", Environmental and Resource Economics, 26(1), 25-43.
Nauges, C. and A. Thomas (2000), ―Privately Operated Water Utilities, Municipal Price Negotiation, and Estimation of Residential Water Demand: The Case of France", Land Economics, 76(1) (February), 68-85.
Nieswiadomy, M. L. (1992), ―Estimating Urban Residential Water Demand: Effects of Price Structure, Conservation, and Public Education", Water Resources Research, 28(3), 609-615.
Nieswiadomy, M. L. and D. J. Molina (1989), ―Comparing Residential Water Demand Estimates Under Decreasing and Increasing Block Rates Using Household Demand Data", Land Economics, 65(3), 280-289.
Nordin, J. A. (1976), ―A proposed modification on Taylor's demand-supply analysis: comment", The Bell Journal of Economics, 7(2), 719-721.
OECD (2003), ―Social Issues in the Provision and Pricing of Water Services, Organisation for Economic Co-operation and Development", Paris.
OECD (1987), Pricing of Water Services, Organisation for Economic Co-operation and Development, Paris.
OECD (1999), The Price of Water: Trends in OECD Countries, Organisation for Economic Co-operation and Development, Paris.
Olmstead, S., M. Hanemann and R. Stavins (2005), ―Do Consumers React to the Shape of Supply? Water Demand under Heterogeneous Price Structures", KSG Faculty Research Working Paper Series, Harvard University.
Pint, M. E. (1999), ―Household Responses to Increased Water Rates during the California Drought", Land Economics, 75(2) (May), 246–266.
Raymond De Young (1985-86)," Encouraging environmentally appropriate behavior: the role of intrinsic motivation", Journal of environmental systems, vol.15(4)
Renwick, E. M. and R. D. Green (2000), ―Does Residential Water Demand Side Management Policies Measure up? An Analysis of Eight California Water Agencies", Journal of Environmental Economics and Management, 40(1), 37-55.
Renwick, E. M. and S. O. Archibald (1998), ―Demand Side Management Policies for Residential Water Use: Who Bears the Conservation Burden", Land Economics, 74(3), August, 343-359.

Renwick, M. E. (1996), ―An Econometric Model of Household Water Demand With Endogenous Technological Change under Demand Side Management Policies", Ph.D. Dissertation, Stanford University.

Renwick, M., R. Green and Ch. McCorkle (1998), ―Measuring the Price Responsiveness of Residential Water Demand in California's Urban Area", California Department of Water Resources, May.

Schefter, J. E. and E. L. David (1985), ―Estimating Residential Water Demand Under Multi-part Tariffs Using Aggregate Data", Land Economics, 61(3), 272-280.

Strand, J. and I. Walker (2005), ―Water Markets and Demand in Central American Cities", Environment and Development Economics, 10(3), 313-335.

Taylor, L. D. (1975), ―The Demand for Electricity: A Survey", The Bell Journal of Economics, 6(1), 74-110.

Taylor, R. G., J. R. McKean and A. Robert (2004), ―Alternate Price Specifications for Estimating Residential Water Demand with Fixed Fees", Land Economics, 80(3), 463-475.

"The Water Framework Directive: A New Directive for a Changing Social, Political and Economic European Framework". European Planning Studies , www.informaworld.com.doi:10.1080/09654310303640. Retrieved 2008-03-23.

TNS Political & Social's report, (May 2012), ―Attitudes of Europeans towards water – related issues", http://ec.europa.eu/public_opinion/flash/fl_344_en.pdf

United Nations (2006), ―World Water Development Report 2 – Water, a Shared Responsibility", World Water Assessment Program, UN.

United Nations (2003), ―World Water Development Report – Water for People, water for Life", World Water Assessment Program, UN.

Wong, S. T. (1972), ―A Model on Municipal Water Demand: A Case Study of Northeastern Illinois", Land Economics, 48 (February), 34-44.

Woo, C. (1994), ―Managing Water Supply Shortage: Interruption vs. Pricing", Journal of Public Economics, 54(1), 145-160.

Young, R. A. (1973), ―Price Elasticity of Demand for Municipal Water: Case Study of Tucson, Arizona", Water Resources Research, 9 (August), 1068-72.

ANNEXES

Tables

Table.1 Descriptive statistics

Variable	Description of the variable	Obs	Mean	St.Dev.	Min	Max
GREENNESS	The variable takes value 0 if an individual declare he/she did not take any action during last two years to reduce water problem, and any value from 1 to 6 indicates number of actions that have been taken by an individual during last two year against water problem.	25524	3.480	1.570	0	6
lim_water	The variable takes value 1 if an individual limited his/her water use during past two years and zero otherwise.	25524	0.805	0.3964	0	1
eco_chem	The variable takes value 1 if an individual used eco-friendly household chemicals during past two years and zero otherwise.	25524	0.541	0.498	0	1
no_pest	The variable takes value 1 if an individual avoided the use of pesticides and fertilizers in the garden during past two years and zero otherwise.	25524	0.602	0.489	0	1
harv_rain	The variable takes value 1 if an individual harvested rain water during past two years and zero otherwise.	25524	0.386	0.487	0	1
org_farm	The variable takes value 1 if an individual used organic farming products during past two years and zero otherwise.	25524	0.459	0.498	0	1
rec_unused	The variable takes value 1 if an individual recycled the environmentally harmful unused materials during past two years and zero otherwise.	25524	0.688	0.463	0	1
EXTRINSIC_MOTIVE	Takes value 1 if an individual thinks ensuring higher financial incentives for efficient water use is effective and zero otherwise.	24516	0.863	0.344	0	1
INTRINSIC_MOTIVE	Takes value 1 if an individual believe environmental impacts of water consumption should be reflected in water price otherwise it takes value 0.	24412	0.633	0.482	0	1
POLICY_KNOWLEDGE_A	Takes value 1 if the respondent is informed about EU's plan of introducing new strategy by the end of 2012 otherwise it takes value 0.	25353	0.0815	0.274	0	1
POLICY_KNOWLEDGE_B	Takes value 1 if the respondent has heard about River Basin Management plans otherwise it takes value 0.	25369	0.128	0 .334	0	1
SPECIFIC_KNOWLEDGE	Takes value 1 if an individual feel him/herself well-informed about problems facing groundwater, rivers, lakes and coastal waters in the country of residence, otherwise it takes zero.	25265	0.390	0.490	0	1
AWARENESS_QUALITY	Takes value 1 if the respondent thinks that water quality problem is serious in his/her country and 0 otherwise.	24831	0.704	0.456	0	1
AWARENESS_QUANTITY	Takes value 1 if the respondent thinks that water Quantity problem is serious in his/her country and 0 otherwise.	24862	0.683	0.470	0	1
Male	Takes the value 1 if individual is male and 0 is female	25524	0.433	0.496	0	1
AGE						
[15-24]	Takes value 1 if an individual's age belongs to [15 , 24] interval and zero otherwise.	25524	0.087	0.281	0	1
[25-39]	Takes value 1 if an individual's age belongs to [25 , 39] interval and zero otherwise.	25524	0.201	0.401	0	1
[40-54]	Takes value 1 if an individual's age belongs to [40, 54] interval and zero otherwise.	25524	0.287	0.452	0	1
55+	Takes value 1 if an individual's age is 55 or greater than 55, otherwise it takes value 0.	25524	0.425	0.494	0	1

Variable	Description of the variable	Obs	Mean	St.Dev.	Min	Max
Living Destricts						
Rural	Takes value 1 if an individual lives in rural destrict, otherwise it takes value 0	25428	0.328	0.469	0	1
Small_Town	Takes value 1 if an individual lives in small or medium-sized town, otherwise it takes value 0.	25428	0.366	0.482	0	1
Large_City	Takes value 1 if an individual lives in large town/city, otherwise it takes value 0.	25428	0.306	0.461	0	1
Occupation						
Selfemployed	Takes value 1 if the respondent is self-employed and zero otherwise.	25450	0.103	0.304	0	1
Unemployed	Takes value 1 if the respondent is unemployed and zero otherwise.	25450	0.482	0.499	0	1
Manualworker	Takes value 1 if the respondent is a manual worker and zero otherwise.	25450	0.079	0.269	0	1
Employee	Takes value 1 if the respondent is an employee and zero otherwise.	25450	0.335	0.472	0	1
Education						
Elementary	Takes value 1 if an individual stopped his/her education before 16 years old and zero otherwise	25239	0.109	0.312	0	1
Secondary	Takes value 1 if an individual stopped his/her education between 16 and 19 years old and zero otherwise	25239	0.381	0.486	0	1
University	Takes value 1 if an individual stopped his/her education after 20 years old and zero otherwise	25239	0.448	0.497	0	1
Student	Takes value 1 if an individual is still student and zero otherwise	25239	0.057	0.233	0	1
Geographical Variables						
Northern_Europe	Takes value 1 if an individual is a resident of northern Europe countries* and zero otherwise.	25524	0.353	0.478	0	1
Eastern_Europe	Takes value 1 if an individual is a resident of eastern Europe countries** and zero otherwise.	25524	0.275	0.446	0	1
Southern_Europe	Takes value 1 if an individual is a resident of southern Europe countries*** and zero otherwise.	25524	0.196	0.397	0	1
Western_Europe	Takes value 1 if an individual is a resident of Western Europe countries**** and zero otherwise.	25524	0.177	0.382	0	1

* Northern Europe countries are: Ireland, Denmark, United Kingdom, Finland, Sweden, Latvia, Estonia and Lithuania

** Eastern Europe countries are: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, and Slovenia

*** Southern Europe countries are: Italy, Spain, Greece, Republic of Cyprus, Portugal, and Malta

**** Western Europe countries are: Belgium, Germany, France, Luxembourg, Netherlands, and Austria.

Table.2 **Logit model- effects of included variables on various water related responses**

	(1) lim_water	(2) eco_chem	(3) no_pest	(4) harv_rain	(5) org_farm	(6) rec_unused
EXTRINSIC_MOTIVE	0.4842***	0.4133***	0.3756***	0.2207***	0.4084***	0.4066***
	(0.0381)	(0.0297)	(0.0297)	(0.0310)	(0.0295)	(0.0340)
INTRINSIC_MOTIVE	0.1615***	0.2415***	0.1308***	0.0577*	0.2470***	0.1553***
	(0.0388)	(0.0303)	(0.0303)	(0.0316)	(0.0302)	(0.0342)
POLICY_KNOWLEDGE_A	-0.0883	0.0374	-0.0586	0.1668***	0.0825	-0.0490
	(0.0675)	(0.0548)	(0.0541)	(0.0548)	(0.0538)	(0.0618)
POLICY_KNOWLEDGE_B	0.1205**	0.2296***	0.1516***	0.2527***	0.1997***	0.1622***
	(0.0580)	(0.0447)	(0.0447)	(0.0452)	(0.0437)	(0.0524)
AWARENESS_QUALITY	0.1639***	0.1470***	0.0973***	0.0481	0.1886***	0.0529
	(0.0429)	(0.0346)	(0.0345)	(0.0356)	(0.0344)	(0.0405)
AWARENESS_QUANTITY	0.3519***	0.1745***	0.0858**	0.2092***	0.1221***	0.0470
	(0.0440)	(0.0366)	(0.0365)	(0.0375)	(0.0363)	(0.0425)
SPECIFIC_KNOWLEDGE	0.1118***	0.2759***	0.1274***	0.2272***	0.2140***	0.2360***
	(0.0409)	(0.0316)	(0.0317)	(0.0323)	(0.0312)	(0.0366)
CONSCIOUSNESS	0.2657***	0.1077**	0.0838**	0.0318	0.1126***	0.0542
	(0.0495)	(0.0431)	(0.0425)	(0.0444)	(0.0430)	(0.0501)
Male	-0.3066***	-0.3859***	-0.2428***	-0.1817***	-0.3964***	-0.1984***
	(0.0384)	(0.0299)	(0.0298)	(0.0310)	(0.0297)	(0.0345)
Age						
[15-24]	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
[25-39]	0.2442***	0.2537***	0.0742	0.3319***	0.2045***	0.3272***
	(0.0859)	(0.0720)	(0.0708)	(0.0784)	(0.0723)	(0.0800)
[40-54]	0.4416***	0.3852***	0.3139***	0.5708***	0.2152***	0.4291***
	(0.0859)	(0.0716)	(0.0706)	(0.0777)	(0.0719)	(0.0798)
55+	0.4759***	0.3685***	0.2915***	0.6391***	0.2646***	0.1975**
	(0.0846)	(0.0712)	(0.0700)	(0.0771)	(0.0714)	(0.0787)
Living districts						
Small_Town	0.1811***	-0.0805**	-0.3336***	-0.4963***	-0.1189***	-0.0542
	(0.0454)	(0.0352)	(0.0358)	(0.0353)	(0.0348)	(0.0408)
Large_City	0.2318***	-0.0021	-0.6277***	-0.9320***	-0.0738**	-0.0641
	(0.0483)	(0.0377)	(0.0379)	(0.0393)	(0.0374)	(0.0430)
Rural	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
Occupation						
Selfemployed	-0.1238*	0.2442***	0.2142***	0.0733	0.3207***	0.2167***
	(0.0669)	(0.0534)	(0.0537)	(0.0548)	(0.0524)	(0.0615)
Manualworker	0.1054	-0.0274	0.0473	0.1414**	-0.0831	0.1543**
	(0.0743)	(0.0600)	(0.0594)	(0.0610)	(0.0598)	(0.0705)
Employee	0.1201**	0.0996***	0.1441***	-0.1009**	0.1943***	0.2387***
	(0.0510)	(0.0386)	(0.0388)	(0.0401)	(0.0382)	(0.0444)
Unemployed	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
Education						
Elementary	-0.4944	0.2193	0.1790	0.4151*	0.4667**	0.2294
	(0.3315)	(0.2296)	(0.2238)	(0.2449)	(0.2375)	(0.2789)
Secondary	-0.3762	0.5074**	0.4311*	0.3743	0.6002**	0.5421**
	(0.3274)	(0.2266)	(0.2208)	(0.2418)	(0.2345)	(0.2760)
University	-0.3461	0.6512***	0.5274**	0.3003	0.8470***	0.6888**
	(0.3267)	(0.2261)	(0.2202)	(0.2411)	(0.2339)	(0.2756)
Student	-0.3061	0.5916**	0.5424**	0.4520*	0.8313***	0.6883**
	(0.3377)	(0.2377)	(0.2319)	(0.2542)	(0.2454)	(0.2873)
Part_Time_Education	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
France	1.2842***	1.4618***	0.5271***	0.2647***	-0.1541	1.9211***
	(0.1520)	(0.1034)	(0.1001)	(0.0985)	(0.0993)	(0.1085)
Belgium	0.9371***	1.3803***	0.3440***	0.5272***	-0.7459***	2.4911***
	(0.1383)	(0.1045)	(0.1008)	(0.1005)	(0.0999)	(0.1230)
Netherlands	0.6191***	1.0805***	0.2894***	-0.5031***	-0.9415***	3.0201***
	(0.1278)	(0.1054)	(0.1020)	(0.1057)	(0.1028)	(0.1421)
Germany	0.2281*	2.4479***	0.8723***	0.8604***	0.2024*	3.0532***
	(0.1203)	(0.1165)	(0.1066)	(0.1032)	(0.1038)	(0.1412)
Italy	0.9400***	1.3983***	0.0446	-1.0720***	-0.2839***	2.0394***
	(0.1406)	(0.1042)	(0.0981)	(0.1131)	(0.0999)	(0.1108)
Luxembourg	0.6175***	1.6688***	0.2529**	-0.3612***	-0.1918	2.1010***

	(0.1630)	(0.1297)	(0.1231)	(0.1250)	(0.1231)	(0.1442)
Denmark	0.5762***	1.9480***	0.3299***	-0.2379**	-0.3156***	3.1073***
	(0.1323)	(0.1150)	(0.1056)	(0.1078)	(0.1060)	(0.1543)
Ireland	0.9184***	0.9944***	0.5417***	-0.5609***	-0.7940***	1.7283***
	(0.1333)	(0.1046)	(0.1025)	(0.1061)	(0.1015)	(0.1083)
United_Kingdom	1.0176***	1.2315***	1.1679***	0.0730	-0.7586***	1.7181***
	(0.1454)	(0.1061)	(0.1118)	(0.1031)	(0.1025)	(0.1102)
Greece	0.9994***	1.3333***	0.6419***	-1.2871***	-0.6443***	1.4139***
	(0.1394)	(0.1031)	(0.0997)	(0.1212)	(0.0988)	(0.1027)
Spain	1.9117***	1.4168***	-0.2042**	-0.9036***	-1.1123***	2.6427***
	(0.1764)	(0.1035)	(0.0974)	(0.1091)	(0.1013)	(0.1224)
Portugal	1.4525***	1.0350***	0.2182**	-0.5629***	-0.6298***	2.1273***
	(0.1625)	(0.1034)	(0.0992)	(0.1044)	(0.0999)	(0.1136)
Finland	-0.3547***	1.8217***	0.1437	0.4299***	0.0145	2.8570***
	(0.1175)	(0.1120)	(0.1043)	(0.1064)	(0.1067)	(0.1371)
Sweden	0.1978	1.8819***	0.4141***	-0.2042*	-0.4210***	3.1111***
	(0.1215)	(0.1105)	(0.1029)	(0.1073)	(0.1035)	(0.1445)
Austria	-0.2050*	2.0866***	0.5821***	0.3731***	0.5323***	2.8461***
	(0.1143)	(0.1110)	(0.1032)	(0.1017)	(0.1068)	(0.1328)
Cyprus	1.5096***	0.6768***	0.1752	-1.6262***	-0.9524***	0.1721
	(0.2140)	(0.1273)	(0.1226)	(0.1703)	(0.1254)	(0.1269)
Czech	0.8954***	1.3313***	0.8219***	0.8477***	-1.0204***	1.7198***
	(0.1364)	(0.1049)	(0.1053)	(0.1024)	(0.1022)	(0.1084)
Lithuania	-1.1200***	0.5415***	0.4641***	-0.0903	-0.9900***	0.1144
	(0.1102)	(0.1069)	(0.1009)	(0.1055)	(0.1034)	(0.1052)
Malta	0.8305***	0.7501***	-1.0172***	0.2900**	-1.4406***	1.2071***
	(0.1744)	(0.1283)	(0.1302)	(0.1256)	(0.1333)	(0.1277)
Estonia	0.1881	0.8303***	0.0762	0.4857***	-0.9246***	1.1914***
	(0.1276)	(0.1152)	(0.1099)	(0.1126)	(0.1134)	(0.1143)
Hungary	0.5344***	1.1135***	0.1225	0.3446***	-1.3316***	0.9777***
	(0.1264)	(0.1041)	(0.0989)	(0.1008)	(0.1045)	(0.1017)
Latvia	0.0392	1.1601***	0.2802***	0.1058	-0.3131***	0.9707***
	(0.1166)	(0.1048)	(0.1003)	(0.1027)	(0.1012)	(0.1030)
Poland	1.0283***	1.1396***	0.2045**	-0.5079***	-0.6738***	1.1483***
	(0.1411)	(0.1031)	(0.0985)	(0.1038)	(0.0993)	(0.1014)
Slovakia	0.5424***	1.4329***	0.4601***	0.5141***	-1.0000***	1.3986***
	(0.1248)	(0.1044)	(0.1008)	(0.1001)	(0.1009)	(0.1037)
Slovenia	0.0156	0.6787***	0.3330***	0.2743***	-1.1613***	1.1276***
	(0.1151)	(0.1031)	(0.0991)	(0.0995)	(0.1012)	(0.1012)
Bulgaria	-0.8150***	0.0804	-0.2474**	-1.2075***	-1.5962***	-0.4744***
	(0.1098)	(0.1089)	(0.0992)	(0.1217)	(0.1081)	(0.1106)
Romania	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
_cons	0.1223	-2.5511***	-0.7155***	-1.1946***	-1.0835***	-2.0847***
	(0.3484)	(0.2520)	(0.2435)	(0.2649)	(0.2570)	(0.2988)
N	22182	22182	22182	22182	22182	22182
pseudo R^2	0.113	0.079	0.051	0.105	0.072	0.166
AIC	18962.8019	28153.484	28156.818	26627.92	28556.9068	22644.5894
BIC	19347.1397	28537.822	28541.156	27012.26	28941.2446	23028.9271

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table.3 Ordered logit model- effects of included variables on reducing water problem

	(i)		(ii)		(iii)		(iv)	
EXTRINSIC_MOTIVE	0.744***	[0.0229]	0.716***	[0.0235]	0.652***	[0.0246]	0.565***	[0.0252]
INTRINSIC_MOTIVE			0.320***	[0.0240]	0.258***	[0.0253]	0.262***	[0.0256]
POLICY_KNOWLEDGE_A					0.00902	[0.0457]	0.0650	[0.0462]
POLICY_KNOWLEDGE_B					0.277***	[0.0367]	0.286***	[0.0371]
AWARENESS_QUALITY					0.0687**	[0.0280]	0.183***	[0.0289]
AWARENESS_QUANTITY					0.202***	[0.0296]	0.237***	[0.0306]
SPECIFIC_KNOWLEDGE					0.366***	[0.0257]	0.310***	[0.0265]
CONSCIOSNESS					0.144***	[0.0358]	0.161***	[0.0362]
Male	-0.352***	[0.0231]	-0.374***	[0.0235]	-0.419***	[0.0249]	-0.442***	[0.0251]
Age								
[15-24]	*Ref.*		*Ref.*		*Ref.*		*Ref.*	
[25-39]	0.765***	[0.0555]	0.788***	[0.0563]	0.631***	[0.0590]	0.571***	[0.0596]
[40-54]	0.669***	[0.0563]	0.680***	[0.0570]	0.606***	[0.0593]	0.573***	[0.0599]
55+	0.357***	[0.0568]	0.360***	[0.0575]	0.379***	[0.0597]	0.359***	[0.0603]
Living Destricts								
Small_Town	-0.327***	[0.0271]	-0.331***	[0.0276]	-0.262***	[0.0290]	-0.282***	[0.0296]
Large_City	-0.660***	[0.0286]	-0.657***	[0.0293]	-0.526***	[0.0309]	-0.431***	[0.0316]
Rural	*Ref.*		*Ref.*		*Ref.*		*Ref.*	
Occupation								
Selfemployed	0.338***	[0.0416]	0.334***	[0.0424]	0.324***	[0.0441]	0.281***	[0.0444]
Manualworker	0.186***	[0.0460]	0.189***	[0.0469]	0.234***	[0.0494]	0.0552	[0.0504]
Employee	0.259***	[0.0301]	0.234***	[0.0307]	0.190***	[0.0320]	0.172***	[0.0323]
Unemployed	*Ref.*		*Ref.*		*Ref.*		*Ref.*	
Education								
Elementary	-0.176	[0.156]	-0.137	[0.169]	0.0801	[0.186]	0.312*	[0.190]
Secondary	0.0612	[0.154]	0.0827	[0.167]	0.291	[0.184]	0.582***	[0.187]
University	0.280*	[0.154]	0.270	[0.167]	0.447**	[0.184]	0.729***	[0.187]
Student	0.440***	[0.165]	0.437**	[0.177]	0.583***	[0.193]	0.760***	[0.196]
Part_time_Education	*Ref.*		*Ref.*		*Ref.*		*Ref.*	
Geographical Variables								
Northern_Europe					0.417***	[0.0342]		
Western_Europe					0.940***	[0.0357]		
Southern_Europe					0.249***	[0.0356]		
Eastern_Europe					*Ref.*			
France							1.331***	[0.0842]
Belgium							1.241***	[0.0853]
Netherlands							0.772***	[0.0869]
Germany							2.034***	[0.0874]
Italy							0.772***	[0.0850]
Luxembourg							1.105***	[0.105]
Denmark							1.287***	[0.0895]
Ireland							0.707***	[0.0863]
United_Kingdom							1.107***	[0.0877]
Greece							0.688***	[0.0840]
Spain							0.692***	[0.0841]
Portugal							0.786***	[0.0847]

	(i)		(ii)		(iii)		(iv)	
Finland							1.314***	[0.0918]
Sweden							1.268***	[0.0889]
Austria							1.703***	[0.0873]
Cyprus							-0.110	[0.104]
Czech							1.219***	[0.0860]
Lithuania							-0.413***	[0.0881]
Malta							0.0794	[0.107]
Estonia							0.473***	[0.0977]
Hungary							0.412***	[0.0860]
Latvia							0.630***	[0.0876]
Poland							0.554***	[0.0851]
Slovakia							0.916***	[0.0859]
Slovenia							0.343***	[0.0860]
Bulgaria							-1.171***	[0.0869]
Romania							*Ref.*	
cut1_Constant	-2.855***	[0.165]	-2.720***	[0.178]	-1.931***	[0.199]	-1.477***	[0.210]
cut2_Constant	-1.265***	[0.162]	-1.107***	[0.175]	-0.279	[0.196]	0.250	[0.207]
cut3_Constant	-0.239	[0.162]	-0.0721	[0.175]	0.796***	[0.196]	1.403***	[0.207]
cut4_Constant	0.722***	[0.162]	0.893***	[0.175]	1.803***	[0.196]	2.474***	[0.207]
cut5_Constant	1.744***	[0.162]	1.923***	[0.175]	2.873***	[0.197]	3.590***	[0.208]
cut6_Constant	3.108***	[0.163]	3.292***	[0.176]	4.285***	[0.198]	5.038***	[0.209]
Observations	25,095		24,047		22,182		22,182	

Standard errors in brackets.

* $p<0.10$ ** $p<0.05$ *** $P<0.01$

Table.4 Marginal effects at the mean value of variables

Mean value of the explanatory variables				
EXTRINSIC_MOTIVE				0.5380713
INTRINSIC_MOTIVE				0.6342163
Male				0.4381004
Age				
[15-24]				0.0886597
[25-39]				0.207635
[40-54]				0.2911798
55+				0.4125255
Living Destricts				
Small_Town				0.3691105
Large_City				0.3026989
Rural				0.3281906
Occupation				
Selfemployed				0.1047948
Unemployed				0.4714102
Manualworker				0.0799684
Employee				0.3438267
Education				
Elementary				0.1055433
Secondary				0.381295
University				0.4499938
Student				0.0586352
Part_time_Education				0.0045328
	Marginal effects at the mean value			
	Margin	Std.Err.	z	P>|z|
Outcome 0	0.0237484	0.0009227	25.74	0.000
Outcome 1	0.0851121	0.0017609	48.33	0.000
Outcome 2	0.1469501	0.0023047	63.76	0.000
Outcome 3	0.2186008	0.0027647	79.07	0.000
Outcome 4	0.2421084	0.0028697	84.37	0.000
Outcome 5	0.1920638	0.0025646	74.89	0.000
Outcome 6	0.0914164	0.0018099	50.51	0.000