Estimating Willingness to Pay for Improvements in Mobile Services

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Submitted to the
Institute of Graduate Studies and Research
in partial fulfilment of the requirements for the degree of

Doctor of Philosophy
in
Economics

Eastern Mediterranean University
May 2016
Gazimağusa, North Cyprus

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ABSTRACT

The prominent approach for estimating people's willingness to pay (WTP) for goods or services not currently in the market is the stated preference approach. Two methods of measuring stated WTP are contingent valuation method and choice experiments. We employ both methods in order to estimate consumers' valuation of improvements in mobile services, focusing on 4G upgrades and roaming services. The contingent valuation method is performed in the payment ladder format, in order to estimate a nominal WTP for 4G. The choice experiment splits up the "mobile service improvement" into attributes, and investigates the preferences for these individual attributes: increased mobile internet speed (possible with 4G), unlimited mobile internet use, improved quality (possible with 4G) and unrestrained use in two neighbouring countries (unrestrained roaming). We collect the data for the study through a face-to-face survey held in all districts of North Cyprus. The results indicate that people value unrestrained roaming services the most. Increased speed and unlimited use attributes are next, and are similarly significant at the 1% level. The impact of improved quality is statistically insignificant at the 5% level, suggesting that consumers are content with the current level of quality they receive with 3G. We conclude that bilateral roaming regulation between governments is more valuable than 4G investments.

Keywords: Mobile telecommunication services, Choice experiment, Willingness to pay, 4G, Roaming.

ÖZ

Hâlihazırda pazarda olmayan ürün veya hizmetler için halkın ödeme istekliliğini (Öİ) tespit etmek adına kullanılan başlıca yaklaşım bahsedilen tercih yaklaşımıdır. Bahsedilen Öİ değerini ölçmenin iki yöntemi olası değerlendirme yöntemi ve seçim deneyleridir. Bu çalışmada tüketicilerin mobil hizmetlerdeki (4G ve dolaşım odaklı) iyileştirmelere biçtiği ekonomik değeri ölçmek için iki yöntemi de kullandık. Olası değerlendirme yöntemi ödeme merdiveni formatında, 4G için ödeme istekliliği değerini tespit etmek adına uygulanmıştır. Seçim deneyi yöntemi mobil hizmet iyileştirmesini parçalarına ayırıp bu parçalar ile ilgili tercihleri tespit etmek amaçlı kullanılmıştır. Bu parçalar mobil internet hızında artış (4G ile mümkün), sınırsız mobil internet kullanımı, iyileşmiş kalite (4G ile mümkün) ve iki komşu ülkede engelsiz kullanımdır (engelsiz dolaşım). Çalışmada kullanılan veri Kuzey Kıbrıs'ın tüm ilçelerinde, yüz yüze mülakat yöntemi ile yapılan bir anket ile elde edilmiştir. Sonuçlar insanların en fazla engelsiz dolaşım hizmetlerine değer verdiğini göstermektedir. Ardından sırasıyla internet hızında artış ve sınırsız kullanım gelmektedir, ve bu iki özelliğin etkileri %1 derecesinde anlamlıdır. İyileştirilmiş kalitenin etkisi %5 derecesinde anlamsızdır, bu da tüketicilerin 3G ile sahip oldukları mevcut kalite seviyesinden memnun olduğunu göstermektedir. Buradan da çift taraflı dolaşım düzenlemelerinin 4G yatırımlarından daha değerli olduğu sonucuna varıyoruz.

Anahtar kelimeler: Mobil telekomünikasyon hizmetleri, Seçim deneyi, Ödeme İstekliliği, 4G, Roaming.

To My Wife & My Son

ACKNOWLEDGEMENT

I am grateful to my supervisor, Prof. Dr. Glenn P. Jenkins, whose expertise, understanding, generous guidance and support made it possible for me to produce this study. It is a pleasure working with him.

I would also like to thank all the faculty members of the Department of Economics at Eastern Mediterranean University. Their contribution to my learning is vast, and their teaching has made my EMU years enjoyable.

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INTRODUCTION

1.1 Introduction

Estimating the welfare impact of public projects and policy changes is an important task in policy making. There are various methods for estimating the value of goods or services currently not on the market, mainly categorized under revealed-preference and stated-preference headings. In this dissertation, we employ a selection of stated-preference methodologies for the valuation of Mobile Telecommunication Services and its attributes in the Turkish Republic of Northern Cyprus (TRNC).

Estimating the value of mobile service improvements for TRNC is currently significant for two reasons. First, the mobile services offered in the North Cyprus market today are out-dated in terms of technology, and therefore there is need for upgrade. The current technology in the market is 3G, whereas the majority of the world has already moved to 4G. Second, the consumers are in greater need to use their mobile services while travelling, especially in Turkey and in South Cyprus. Operators are charging excessively for roaming in Turkey, and roaming in South Cyprus is not available at all due to the present political problem. We estimate the value for suggested improvements in mobile services, which will be an important input for telecommunications policy-making and for the design of the next mobile tender in TRNC.

In order to evaluate the improvements individually, we employ the Choice Experiments methodology which enables us to break down the mobile services into the individual attributes which we intend to study. We also analyse the impact of demographics such as age, gender, education and income, on the valuation of mobile services, by using the Contingent Valuation methodology.

1.2 Mobile Communications

Advances in telecommunications have turned the world into a more connected, more 'globalized' place in the 20th century, and have been a major contributor to increased economic efficiency and productivity in every possible sector. Technological progress in telecommunications continues to change the way we live our lives in the 21st century.

Mobile communications (MC) has been the star of telecommunications in the past two decades. Initially MC was a means for speaking and texting over mobile phones using 1G and later GSM (2G) technologies. The introduction of 3G enabled mobile users to connect to the internet and to send and receive various multimedia messages. Then 4G arrived, making it possible to access mobile internet with speeds that even some fixed broadband technologies cannot achieve. The International Mobile Telecommunications Advanced specification sets the peak speed requirements for 4G service at 100 Mbps for high mobility communication and 1 Gbps for low mobility communication (ITU, 2008). Commercial 4G networks have not yet achieved the peak speeds of the specification, although they have spread rapidly around the world since the early 2010s. As of November 2014, there are 331 4G LTE networks offering varying data connection speeds, deployed in 112 countries. The top speeds available are offered by 21 commercial 4G LTE-A CA networks launched in 14 countries, subscribers of which enjoy downlink data speeds ranging from 225 Mbps to 300 Mbps (Ericsson, 2014).

Numerous prior studies have focused on the MC sector. However, rapidly changing technologies continue to open up new territories for academic and empirical research. Previous literature has touched on MC licensing and auctions (Klemperer, 2002; Fuentelsaz et al., 2008), mobile tariff discrimination (Haucap and Heimeshoff, 2011), mobile roaming (Fabrizi and Wertlen, 2008; Stühmeier, 2012), MC adoption (Rice and Katz, 2003; Pagani, 2004; Bouwman et al., 2007), and consumer preferences for MC services (Kim, 2005; Shin et al., 2011; Kwak and Yoo, 2012; Klein and Jakopin, 2014). In this dissertation, we present a brand-new study on the last of the subject areas in this list.

1.3 MC Improvements

Our study is focused towards estimating consumer preferences and their determinants for a selection of 'current and crucial' improvements in MC services. The attributes we evaluate are: increased mobile internet speed, unlimited mobile internet use, improved quality of communications service, and unrestrained use abroad. These service upgrades are missing in most mobile markets around the world, and each one is of interest for a reason.

Although 4G is deployed in many countries, there are still many regions that are not covered, and many more that are covered but lagging behind in terms of 4G technology. Consumers of mobile services in these regions have yet to fully benefit from the features of 4G, namely increased mobile internet speed and improved quality. Therefore, understanding the value of introducing these features continues to be of interest. Unlimited mobile internet use is interesting because most mobile broadband services on offer have data caps, whereas fixed broadband services generally provide unlimited use. Mobile broadband could become a competitor of fixed broadband if offered with unlimited use, so we aim to quantify the value that consumers associate with this attribute. Finally, unrestrained use abroad is of interest because people are travelling more than ever, and operators are charging excessively for roaming mobile services. The reason for high roaming prices is the lack of competition at the level of inter-operator tariff negotiation (Salsas and Koboldt, 2004; Sutherland, 2012). The EU has taken steps to regulate its roaming market (Shortall, 2010; Infante and Vallejo, 2012), and recently independent countries have started to make bilateral agreements for coordinated action on roaming services (Singapore and Malaysia in 2011 (The Independent, 2011), Australia and New Zealand in 2013 (MBIE, 2013)). We might expect to see more countries follow suit in the near future, if the value for the consumers is depicted more clearly.

Our aim in this study is to evaluate consumers' willingness to pay (WTP) for the abovementioned attributes, as a measure of their value. We conduct 320 face-to-face interviews with people from all regions of North Cyprus, asking respondents to choose between their existing mobile service and two other hypothetical alternatives with varying attribute levels. We estimate consumers' marginal WTP (MWTP) for each attribute by analysing how they trade off between price and other attributes when making their choices. We also examine the sensitivity of the WTP for 4G with regard to demographic characteristics, such as age, gender, education and income levels.

North Cyprus is a developing economy in the Eastern Mediterranean with a population slightly below 300,000. Mobile use is spread widely throughout the country and the currently available mobile technology is 3G. The results of this study are useful for the government of North Cyprus in designing a possible auction or tender for 4G licensing, and for mobile network operators in analysing the costs and benefits of future 4G investment. Similarly, these results should be of interest for all developing countries, and especially for Turkey, the 20th largest mobile market in the world in terms of number of subscribers in 2013 (ITU, 2015). Like North Cyprus, Turkey has not yet introduced 4G (as of the date of the study), and the same operators dominate both the Turkish market and the market in North Cyprus (Turkcell and Vodafone).

To the best of our knowledge, this is the first study in literature estimating the value of various levels of 4G data rates, including the top rate possible as of today. Our model allows us to estimate non-linear effects of data rates on consumer utility. We specifically test for a modest improvement to 30 Mbps, and for a more advanced upgrade to 300 Mbps. We aim to quantify the MWTP for each speed level separately, so we can evaluate whether there is sufficient demand for the most advanced technology, or whether the consumers are indifferent between the two levels. This study is also unique because it is the first attempt in MC literature to estimate the value of free roaming (use as in homeland) for the consumers. We expect that the results will draw attention to bilateral roaming regulation, which very few states (EU, Singapore-Malaysia, Australia-New Zealand) have introduced until today.

1.4 Dissertation Outline

This dissertation is organised as described in the following. Literature review is presented in Chapter 2. The chapter covers the methodologies to evaluate the willingness to pay for a service or commodity. In particular, we lay the theoretical framework for the Averting Expenditure, Choice Experiment, and Contingent

Valuation methodologies. Chapter 3 contains the steps followed for the design of the Choice Experiment that we use in this dissertation to study the demand for various improvements in mobile services. Chapter 4 depicts the contents of the questionnaire and discusses the administration of the survey. The chapter also presents the survey statistics. Chapter 5 revisits the CE model, and displays the results of the CE analysis. Chapter 6 presents the CVM findings, and also contains a sensitivity analysis which estimates the relation of WTP with demographic characteristics. Last, Chapter 7 discusses the results of the study and concludes.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

There are two main approaches to estimating Willingness-To-Pay values for a service improvement: the revealed preference approach and the stated preference approach.

The revealed preference approach estimates WTP by observing people's actions which reveal their preferences. The Averting Expenditure method is the method commonly used in this approach. This methodology measures WTP by observing the actual expenditures made by consumers in order to cope with the shortage of the service in question. By observing this "averting" expenditure of consumers, their revealed WTP can be estimated.

The stated preference approach, on the other hand, estimates WTP by asking people to state their preferences. We employ two methods of measuring stated WTP: Contingent Valuation method and Choice Experiments.

The Contingent Valuation method of measuring stated WTP involves surveying consumers and asking them to state their willingness to pay for the service improvement directly. This method of valuing WTP was first proposed by Siegfried von Ciriacy-Wantrup (1947) as a method of quantifying the benefits of a good or a service which is not available in the market. As part of a contingent valuation study, we held a survey in North Cyprus in order to understand the importance of 4G service for the consumers and to elicit their valuation of high-speed mobile service.

The Choice Experiments (CE) method is similar to the Contingent Valuation method in that it involves surveying people to elicit WTP information. However, contrary to CVM which produces one estimate for the total value of the service upgrade, CE method can be used to calculate marginal WTP values for several attributes of the service improvement. By this way, CE method enables us to fulfil the main purpose of a CBA analysis, which is to assess and compare various alternatives of a project.

2.2 Willingness-To-Pay or Willingness-To-Accept?

In previous sections, we stated that we take on estimating Willingness-To-Pay values in order to quantify the magnitude of demand for MC improvements. However, why should we use Willingness-To-Pay, and not Willingness-To-Accept? What is the difference between WTP and WTA, in the first place? We first touch the literature on WTP and WTA.

In order to put things into context, let us focus on a single quality improvement in the mobile service: the mobile internet speed, and let us denote the level of the speed available to a consumer with S. When the speed rises from a level of S^0 to S^1, the consumer's utility increases from U^0 to U^1. The welfare impact of the quality improvement in the mobile internet service refers to the economic value of the improved quality for the consumer. This value can be measured in two ways: the compensating variation and the equivalent variation (Silberberg and Suen, 2001).

Compensating variation (CV) is the amount which should be removed from income at the new speed level S^1, in order to bring the consumer back to the initial utility level

U^0. In other words, CV measures the consumer's maximum willingness to pay (WTP) for the quality improvement. The indirect utility representation of compensating variation would be as follows:

$$V(p^0, S^0, Y) = V(p^0, S^1, Y - CV)$$

where V is the indirect utility function, p^0 is the vector of prices and Y is the consumer's income. Using the expenditure function $e(.)$, we can rearrange this equation to write CV explicitly:

$$CV = e(p^0, S^0, U^0) - e(p^0, S^1, U^0)$$

Equivalent variation (EV) is the amount of income which the consumer should be granted at the initial speed level S^0 in order to move the consumer from the utility level U^0 to U^1. In other words, EV refers to the minimum willingness of the consumer to *accept* (WTA) not to receive the speed upgrade. Again, using indirect utility function, we represent this as:

$$V(p^0, S^0, Y + EV) = V(p^0, S^1, Y)$$

Rearranging to express EV explicitly using the expenditure function:

$$EV = e(p^0, S^0, U^1) - e(p^0, S^1, U^1)$$

WTP and WTA values for a quality improvement are usually not equal to each other (Randall & Stoll, 1980; Horowitz & McConnell, 2002; Biel, Johansson-Stenman & Nilsson, 2006). WTA figures are greater than WTP figures, due to reasons such as income and substitution effects, price flexibility of income, and the tendency for loss aversion. Because of the sizable differences in the absolute values of WTP and WTA, we need to make a choice in order to assign a value for the welfare impact of the service improvement. Practitioners of the CBA like Mitchell and Carson (1989) or the members of the NOAA panel (1993) recommend to always use WTP for practical purposes, since WTP is the conservative choice and should be preferred to be on the safe side.

2.3 Revealed Preference Approach

Revealed Preference techniques for estimating WTP for a service quality improvement include direct demand estimation, hedonic price analysis, travel cost analysis, cost of illness analysis, and averting expenditure analysis. Direct demand technique necessitates adequate time-series sales data, the prices of the service sold, the level of the service quality, and other economic data such as income data, other relevant prices in the market, and demographic data. Due to the unavailability of this kind of data, especially in developing countries, this technique is rarely used. On the other hand, hedonic price, travel cost analysis, and cost of illness analysis are specifically used for the assessment of environmental policies. Averting expenditure analysis is the approach most widely used.

2.3.1 Averting Expenditure

The Averting Expenditure method makes use of the theory of production function (Becker, 1965; Bockstael & McConnell 1999). According to this theory, consumer's utility is a function of commodities and services which the consumer produces herself, and the characteristics of the consumer. Rearranging the production theory for our purposes, we can state consumer's utility to be a function of MC dependent services, commodities/services other than the MC dependent services, and the consumer's characteristics.

$$U = U(Z(N, A, S), X, \tau)$$

where Z is the production function of MC dependent services (talking, messaging, surfing the net, gaming, etc.), N is the amount of the mobile service used, A is the amount of averting actions, S is the speed of current mobile service available to the consumer, X is the amount of other commodities and services consumed, and τ represents the characteristics of the consumer. Given the speed of current mobile service available to the consumer (if the consumer decides to subscribe), the consumer picks the minimum amount to spend, as averting expenditure, in order to produce the optimum level of MC dependent services that will maximise her utility subject to her budget constraint. Put differently, the consumer has an optimal level of MC dependent services, which depends on her income, prices, consumption of other goods, characteristics, among other things. Therefore, if the real speed S of current mobile service available to the consumer is not sufficient to produce the consumer's optimal level of MC dependent services, the consumer partakes in averting behaviour that will raise these services to the desired level.

Bartik (1988) shows the lower and upper bounds of the welfare impact of a reduction in pollution can be calculated using averting expenditure data. Using the approach of Bartik (1988), we lay the theoretical framework for using AE method to calculate the lower bound of the welfare impact of a mobile service upgrade.

The cost function of producing MC dependent services, $C_Z(.)$ is defined as:

$$C_Z = C_Z(Z(N, A, S), p_N, p_A, S)$$

where p_N is the price of current mobile service, and p_A is the price vector of the averting actions. Let Z^* be the optimal level of MC dependent services for a consumer that faces current mobile internet speed level S^0. If the mobile speed rises from S^0 to S^1, the cost to produce this optimal level Z^* decreases by:

$$C_Z(Z^*, p_N, p_A, S^0) - C_Z(Z^*, p_N, p_A, S^1)$$

Let us denote the restricted expenditure function $e(.)$ which gives the minimum expenditure needed to provide utility U when mobile internet speed available is S, the prices are p, and the consumer's optimal level of MC dependent services is restricted to Z, as follows:

$$e(p, S, U;\ Z)$$

We can argue that, when mobile internet speed rises from S^0 to S^1, the decrease in expenditures needed to achieve the optimal level of services Z^*, is equal to the drop in the cost of producing Z^*:

$$e(p, S^0, U^0) - e(p, S^1, U^0;\ Z^*) = C_Z(Z^*, p_N, p_A, S^0) - C_Z(Z^*, p_N, p_A, S^1)$$

Rearranging the equation above:

$$e(p, S^0, U^0) = C_Z(Z^*, p_N, p_A, S^0) - C_Z(Z^*, p_N, p_A, S^1) + e(p, S^1, U^0;\ Z^*)$$

We can substitute in the expression for the CV of an upgrade in the speed of mobile internet, which we derived in section 2.2:

$$CV = e(p, S^0, U^0) - e(p, S^1, U^0)$$

and we arrive at the following equation:

$$CV = C_Z(Z^*, p_N, p_A, S^0) - C_Z(Z^*, p_N, p_A, S^1) + e(p, S^1, U^0;\ Z^*) - e(p, S^1, U^0)$$

Notice that, on the right hand side of the equation, the third term is larger than the last term. With the mobile speed improved to S^1, the required expenditure to achieve utility U^0 is larger if the level of internet dependent services is restricted to Z^*. This is because, if the level of Z is not restricted, utility U^0 can be achieved with fewer expenditure by allowing people to increase their level of Z. Therefore, the CV of service quality improvement is equal to the drop in the cost of producing Z^* and a positive term. Hence, we may conclude the cost savings achieved by improving mobile speed S when holding Z constant is a minimum estimate of the welfare impact of the mobile internet speed change.

The consumer utility maximization problem is:

$$Max_{X,N,A}\ U(Z(N,A,S),X,\tau)\ subject\ to\ C_Z(Z,p_N,p_A,S)+p_XX\leq Y,and$$

$$C_Z(Z,p_N,p_A,S)=\mathrm{Min}_{A,N}\ (p_AA\ +\ p_NN)\ subject\ to\ Z=Z(N,A,S)$$

The solution to this utility maximization problem is given by the indirect utility function,

$$V=V(p_X,p_N,p_A,Y,S,\tau)$$

Using Roy's theorem, we can obtain the optimum level of averting actions:

$$A=\frac{\partial C_Z}{\partial p_A}=-\frac{\partial V/\partial p_A}{\partial V/\partial Y}=A\big(p_X,p_N,p_A,S,Z(p_N,p_A,p_X,Y,S,\tau)\big)$$

2.4 Stated Preference Approach

Stated Preference Approach for estimating Willingness-To-Pay for a service quality improvement involves extracting the value people associate with the quality improvement via surveys. Two common techniques, which we will employ for mobile service improvement in North Cyprus as well, are Contingent Valuation Methodology and Choice Experiments Methodology.

2.4.1 Contingent Valuation Methodology

In the CVM method, a survey is held and respondents are asked to state their WTP directly. This method is used to evaluate a variety of goods and services. Several examples include: Amirnejad, Hamid, et al. (2006) estimating the existence value of north forests of Iran; Lee, Choong-Ki, and Sang-Yoel Han (2002) estimating the use and preservation values of national parks' tourism resources in South Korea; and

Montes de Oca and Bateman (2006) estimating WTP for water services in Mexico City.

Although CVM is widely used for estimating WTP, this methodology has its critics. Venkatachalam (2004) reviews the possible pitfalls of CVM, which it has often received criticism for:

Embedding effect: Variation in estimated WTP for a commodity or service depending on whether it is evaluated on its own or as part of a bundle.

Sequencing effect: Variation in estimated WTP depending on the order in which it is asked in the survey (in studies estimating WTP for more than one good).

Information effect: Variation in estimated WTP due to the level of information provided.

Elicitation effect: Variation in estimated WTP due to the elicitation technique used (bidding game, payment card, open-ended elicitation technique, single-bounded dichotomous choice approach, double-bounded dichotomous choice approach).

Hypothetical bias: Divergence between true WTP and stated WTP

Strategic bias: Occurs if the survey takers hide their true WTP for strategic reasons.

Payment vehicle bias: Variation in estimated WTP due to the type of payment vehicle (income tax, entry fee, utility bill, etc.).

Despite the criticisms, there are ways suggested in the literature to keep potential biases to a minimum, and CVM continues to be an effective tool to elicit WTP information (Whittington 1998; List, 2001; Arrow et al., 2001).

2.4.1.1 Theory behind the CVM Method

There are three different approaches within the CVM methodology, as follows:

Random utility approach: This approach starts from the utility function, and makes assumptions about the functional form of the utility function and the probability distribution of the error term in the utility function.

Parametric modelling of the WTP: This starts from the WTP function, and makes assumptions about the functional form of the WTP function and the error term of the WTP function.

Non-parametric modelling of the WTP: Starts from the WTP function, and makes some assumption about the shape of the WTP function (as few assumptions as possible) and no assumption about an error term (deterministic model).

2.4.1.2 Random Utility Approach in CVM

The random utility approach, as the name suggests, makes use of the random utility theory. In order to demonstrate, we follow Hanemann (1984) and we adopt his approach to our mobile services case.

Let us assume, as part of the CVM study, an individual q is told the speed of the mobile service will increase from S^0 to S^1, and the cost of this improvement will be B_q. Then the individual is queried as to whether she is willing to pay the cost B_q for the improvement in the mobile internet speed. The individual's response, represented by variable i, is either a "yes" (in which case, i = 1), or a "no" (i = 0).

The utility of the individual q from alternative i is made of an observable component and a random component:

$$U_{iq} = V_{iq} + \varepsilon_{iq}$$

The component V_{iq} is observable to the researcher, and the random component ε_{iq} is not. V_{iq} is given by:

$$V_{iq} = V_{iq}(p_X, p_N, p_A, S, Y; \tau_q)$$

where p_N is the price of mobile service, p_A is the price vector for the averting actions, p_X is the price vector of all other goods/services, S is the speed of mobile internet, Y is income, and τ_q is a vector of the individual's characteristics.

When asked whether she is willing to pay the amount B_q, the individual will accept the offer if her utility after paying the amount B_q to reach speed S^1 is greater than, or at least equal to, her initial utility at speed S^0 and not having paid the amount B_q. This is to say, she will accept the offer if:

$$V_{1q}(p_X, p_N, p_A, S^1, Y - B_q; \tau_q) + \varepsilon_{1q} \geq V_{0q}(p_X, p_N, p_A, S^0, Y; \tau_q) + \varepsilon_{0q}$$

Rearranging;

$$V_{1q}(p_X, p_N, p_A, S^1, Y - B_q; \tau_q) - V_{0q}(p_X, p_N, p_A, S^0, Y; \tau_q) \geq \varepsilon_{0q} - \varepsilon_{1q}$$

The right hand side is not observable to the researcher, and therefore it is a random variable. Hence, the response of the individual is also a random variable. We can express its probability distribution as follows:

$$P_{1q} = P\big(V_{1q}(p_X, p_N, p_A, S^1, Y - B_q; \tau_q) - V_{0q}(p_X, p_N, p_A, S^0, Y; \tau_q) \geq \varepsilon_{0q} - \varepsilon_{1q} \big)$$

P_{1q} is the probability the individiual is willing to pay the cost. Then, the probability that the individual is not willing to pay the cost, P_{0q}, is given by:

$$P_{0q} = 1 - P_{1q}$$

Assuming the random errors are independent and identically distributed with a mean of 0, we can define $\eta = \varepsilon_{0q} - \varepsilon_{1q}$, and let F_η be the cumulative distribution function of η. Then, P_{1q} and P_{0q} are shortly:

$$P_{1q} = F_\eta(\Delta V), P_{0q} = 1 - F_\eta(\Delta V), where\ \Delta V = V_{1q} - V_{0q}.$$

Now, let I_q be an indicator variable for the individual q. Then, the log-likelihood function for all N individuals in the survey is:

$$\log L = \sum_{q=1}^{N} I_q \ln F_\eta(\Delta V) + (1 - I_q) \ln \big(1 - F_\eta(\Delta V)\big)$$

At this point, in order to carry out a Maximum Likelihood estimation and find the parameters that maximize the likelihood, we need to make assumptions about the functional form of the utility function and the distribution of the error term. The simplest assumptions would be a linear utility function and a normal distribution for the error terms (Probit). The utility function would be given as:

$$U_{iq} = V_{iq} + \varepsilon_{iq}$$

$$U_{iq} = \alpha_i + \mu Y + \varepsilon_{iq}$$

The utility levels for the responses “Yes” and “No” are:

$$U_{0q} = \alpha_0 + \mu Y + \varepsilon_{0q}$$

$$U_{1q} = \alpha_1 + \mu(Y - B_q) + \varepsilon_{1q}$$

ΔV is given by:

$$\Delta V = V_{1q} - V_{0q} = \alpha_1 - \alpha_0 - \mu B_q = \alpha - \mu B_q, where\ \alpha = \alpha_1 - \alpha_0.$$

From our previous result we have:

$$P_{1q} = P(\Delta V \geq \varepsilon_{0q} - \varepsilon_{1q}) = P(\alpha - \mu B_q \geq \eta)$$

Since we assumed error term to be normally distributed, η is also I.I.D. (independent identically distributed) with normal distribution:

$$\eta \sim N(0, \sigma^2)$$

In order to convert this into a standard normal distribution, we define θ:

$$\theta = \eta/\sigma\ ,\ \ \theta \sim N(0,1)$$

Then P_{1q} is:

$$P_{1q} = P(\eta \leq \alpha - \mu B_q) = P\left(\frac{\eta}{\sigma} \leq \frac{\alpha}{\sigma} - \frac{\mu}{\sigma} B_q\right) = P\left(\theta \leq \frac{\alpha}{\sigma} - \frac{\mu}{\sigma} B_q\right) = \Phi\left(\frac{\alpha}{\sigma} - \frac{\mu}{\sigma} B_q\right)$$

where $\Phi(.)$ is the cumulative distribution function of standard normal distribution. We can therefore estimate two parameters $\frac{\alpha}{\sigma}$ and $\frac{\mu}{\sigma}$.

Remember we are interested in WTP. We can use the estimations of these parameters in order to calculate the mean and the median of WTP. The mean (or expected value) of WTP is the most natural measure of WTP. The median is of interest because this is the level of WTP at which there is 50:50 chance that the response will be “Yes”.

Here is how to solve for mean and median WTP. WTP is the maximum amount of money an individual is willing to pay for the service improvement, so she is indifferent between having the service improvement and not having the service improvement:

$$\alpha_0 + \mu Y + \varepsilon_{0q} = \alpha_1 + \mu\left(Y - WTP_q\right) + \varepsilon_{1q}$$

Solving for WTP gives:

$$WTP_q = \frac{\alpha+\eta}{\mu}$$

Then the mean (expected value) is given as:

$$E\left[WTP_q\right] = E\left[\frac{\alpha+\eta}{\mu}\right] = \frac{\alpha}{\mu} + \frac{E[\eta]}{\mu} = \frac{\alpha}{\mu}$$

The median, represented by WTP^*, is the willingness to pay amount at which there is 50 per cent chance the response will be "Yes":

$$P_{1q} = F_\eta\left(\Delta V(WTP_q^*)\right) = 0.5$$

Since we assumed error term to be normally distributed, the above occurs when:

$$F_\eta(0) = 0.5$$

and hence:

$$\Delta V\left(WTP_q^*\right) = \alpha - \mu WTP_q^* = 0$$

Solving for WTP_q^*, we get the median of WTP to be the same as mean WTP:

$$WTP_q^* = \frac{\alpha}{\mu}$$

2.4.1.3 Parametric Modelling of the WTP in CVM

Alternatively, we can start with specifying a functional form of WTP and a distributional assumption about the error term in the WTP function. Let us again make the simplest assumptions; a linear WTP function and a normal distribution for the error term. The linear WTP function is given by:

$$WTP_q = \beta X_q + \varepsilon_q$$

The probability that the respondent is willing to pay the cost B_q is expressed as follows:

$$P_{1q} = P(WTP_q > B_q) = P(\beta X_q + \varepsilon_q > B_q) = P(\varepsilon_q > B_q - \beta X_q)$$

$$P_{1q} = 1 - F_\varepsilon(B_q - \beta X_q) = F_\varepsilon(\beta X_q - B_q)$$

$$P_{1q} = P(WTP_q > B_q) = 1 - F_{WTP}(B_q)$$

By making an assumption about the distribution of the error term, we also make an assumption about the distribution of WTP itself. Since we assume a normal distribution, we will get:

$$\varepsilon_q \sim N(0, \sigma^2) \quad and \quad WTP_q \sim N(\beta X_q, \sigma^2)$$

$$P_{1q} = P(WTP_q > B_q) = 1 - \Phi\left(\frac{B - \beta X_q}{\sigma}\right) = 1 - \Phi\left(\left(\frac{1}{\sigma}\right) B_q - \beta^* X_q\right) \quad where\ \beta^* = \frac{\beta}{\sigma}$$

We can now estimate β^*. The mean WTP and median WTP are again the same and given by:

$$E[WTP_q] = E[\beta X_q + \varepsilon_q] = \beta X_q = \hat{\sigma}\beta^* X_q$$

$$WTP_q^* = \beta X_q = \hat{\sigma}\beta^* X_q$$

However, note that our assumptions have put very little restrictions on WTP, especially they allowed for a negative WTP. In most cases this is not realistic. Assuming an exponential form for WTP would restrict WTP to the positive domain:

$$WTP_q = \exp(\beta X_q + \varepsilon_q)$$

Doing the same derivations as above, we end up with:

$$P_{1q} = 1 - \Phi\left(\left(\frac{1}{\sigma}\right) \ln B_q - \beta^* X_q\right)$$

$$E[WTP_q] = \exp(\hat{\sigma}\beta^* X_q)\exp\left(\frac{1}{2}\hat{\sigma}^2\right)$$

2.4.1.4 Non-Parametric Modelling of the WTP in CVM

The parametric approaches to estimate WTP described above require assumptions about distributions, and therefore they risk resulting in erratic results if the assumptions do not hold. As an alternative, several studies (Turnbull, 1976; Kriström, 1990) suggested a non-parametric approach to estimating WTP using a CVM survey.

In this non-parametric approach, respondents of the CVM survey are asked to answer "Yes" or "No" to whether they are willing to pay a cost of B. There are m different costs presented to m different samples with each sub-sample i having n_i individuals. If we let k_i represent the number of individuals saying "Yes" to B_i in each sub-sample i, then the proportion of "Yes" answers in this sub-sample is given by $p_i = \frac{k_i}{n_i}$. Calculating p_i for all sub-samples $i = 1$ to m, we end up with a sequence $p_1, p_2, p_3, \dots, p_{m-1}, p_m$ which can be interpolated with an appropriate rule to arrive at a function for the probability of Yes answers in terms of the bid amount B. Mean willingness to pay can simply be estimated as the area under this curve.

"Kaplan-Meier-Turnbull" and "Spearman-Karber" estimations are two commonly used non-parametric estimates of mean WTP. The KMT and SK estimators are given by:

$$E_{KMT}[WTP] = \sum_{i=1}^{m} B_i(p_i - p_{i+1})$$

$$E_{SK}[WTP] = \sum_{i=1}^{m}\left(\frac{(B_i + B_{i+1})(p_i - p_{i+1})}{2}\right)$$

2.4.2 Choice Experiments Methodology

Origins of the CE methodology date back to Louis L. Thurstone's 1927 paper in Psychological Review on paired (comparison) choice experiments. Many authors have contributed to the literature on choice analysis, and the final methodology of Choice Experiments draws upon Lancaster's economic theory of value (Lancaster, 1966) and random utility theory (McFadden, 1973; Hanemann, 1984). CE is now commonly used in various fields of economics and marketing to make choice-based valuations of goods, services and their attributes.

What sets CE apart from CVM is that CE allows researchers to study not only the value of a commodity itself, but also the values of various attributes of this commodity. These *attributes* are the main sources influencing people's decisions, and hence, the value people associate to each attribute is precious information. In order to extract this information, the CE practitioner designs *choice sets* which contain different levels of the attributes, and asks people in a survey to make choices between these sets. By this way, the CE practitioner is able to analyse the marginal effect of each individual attribute.

In the context of this dissertation, Choice Experiments methodology enables us to decompose the improvement in mobile service into various attributes, such as the speed of the mobile internet service, the quality, the amount of use offered (i.e. whether the service is limited or unlimited), and more. While CVM produces a single value of WTP for the service improvement, CE estimates a separate marginal WTP for each individual attribute studied. Therefore, with Choice Experiments, we are able to assess and compare various alternatives for the MC improvement project, and produce more meaningful policy implications.

Choice Experiments are widely used in estimating the welfare impact of public policies. Several examples include valuing forest landscapes in UK (Hanley, Wright and Adamowicz, 1998), wetlands in South Sweden (Carlsson, Frykblom and Liljenstolpe, 2003) and health programs in US, UK, Australia and Canada (Ryan and Gerard, 2003). Choice Experiments have also been used to analyse the demand for mobile services which is the focus of this dissertation. Kim (2005) estimated consumer preferences for IMT-2000 (3G) services in South Korea, Shin et al. (2011) carried out a similar conjoint analysis for mobile service consumption in Uzbekistan, and the first CE study evaluating consumers' preferences for 4G technology was by Kwak and Yoo (2012).

2.4.2.1 Theory behind the CE Methodology

As stated before, CE methodology makes use of the random utility theory. An individual, when faced with an alternative i, derives a utility from this alternative as follows:

$$U_i = V_i + \varepsilon_i$$

The component V_i is observable to the researcher, and the random component ε_i is not. The observed component V_i is where the set of attributes which are observable and measurable reside. The simplest assumption for V_i would be that it is a linear function of the attributes, each of which is weighted by a unique weight to account for that attribute's marginal utility input. Using f as a generalized notation for functional form but noting that the functional form can be different for each attribute, we can write V_i as:

$$V_i = \beta_{0i} + \beta_{1i} f(X_{1i}) + \beta_{2i} f(X_{2i}) + \beta_{3i} f(X_{3i}) + \cdots + \beta_{Ki} f(X_{Ki})$$

where X_{ki} represent the $k = 1$ to K attributes of alternative i, β_{ki} represent the weights of these attributes, and β_{0i} is a parameter which is not associated with any observed attribute but represents the role of all unobserved sources of utility.

If we treat each attribute to be linear so that $f(X) = X$, and if we assume the random component of utility ε_i to be inclusive of all sources of variance from unobserved components of β and X, and also if we assume ε_i to be IID (independently and identically distributed), we end up with the Multinomial Logit (MNL) model:

$$U = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_K X_K + \varepsilon$$

The assumption that all sources of variance are encapsulated by ε is a very strong assumption, and it might not always be realistic. For example, the MNL model assumes the attributes that are not included in the observed part of the utility expression are represented by the unobserved component and of identical impact for each alternative. If the alternatives are mobile service technologies (i.e. GSM, 3G, 4G, etc), and the data rate is missing in the attributes, it would be unrealistic to assume data rate has the exact same influence on the choice of each alternative (ie. 3G vs. 4G). Moreover, sometimes an attribute is common to two or more alternatives. If this attribute is excluded from the observed part of the utility expression, then its inclusion in the unobserved component will introduce correlation between alternatives, and the IID assumption will be violated. Therefore, when there is concern that there will be correlation between alternatives because of an inability to accommodate the sources of this in the observed part of utility, one should opt for a less restrictive model. For instance, Nested Logit model and Mixed Logit model have fewer restrictions compared to MNL. Nested Logit model allows to partition the choice set in a way that constant variance assumption holds among alternatives in the same partition while allowing differential variance between partitions. Mixed logit, on the other hand, is even less restrictive and permits correlation between all pairs of alternatives. There are various other models as well, that we will not dwell on here.

Once the form of the utility expression is identified, we turn to how an individual makes a choice in a Choice Experiment. Suppose the individual faces $j = 1$ to J alternatives. In order to make a choice, the individual will evaluate the utility she will derive for each alternative and pick the one with the highest utility. Putting this into notation, the probability that alternative i will be chosen is:

$$P_i = P\left(\left(U_i \geq U_j\right) \forall\, j \in j = 1, \dots, J; i \neq j\right)$$

Rearranging;

$$P_i = P\left(\left(V_i + \varepsilon_i \geq V_j + \varepsilon_j\right) \forall\, j \in j = 1, \dots, J; i \neq j\right)$$

$$P_i = P\left(\left((\varepsilon_j - \varepsilon_i) \leq (V_i - V_j)\right) \forall\, j \in j = 1, \dots, J; i \neq j\right)$$

Since the error term is not observable, estimating the model requires picking up a probability distribution for the error term. A popular distribution in discrete choice analysis is the extreme value type 1 (EV1) distribution, which has the following form:

$$P\left(\varepsilon_j \leq \varepsilon\right) = \exp(-\exp -\varepsilon)$$

Equipped with the IID and EV1 assumptions, we can proceed to complete the model. Louviere, Hensher and Swait (2000, chapter 3) take on the full derivation of the Multinomial Logit (MNL) model, and end with the following:

$$P_i = \frac{\exp V_i}{\sum_{j=1}^{J} \exp V_j} \;; \quad j = 1, \dots, i, \dots, J \quad i \neq j$$

In words, this states that the probability of an individual choosing alternative i out of J alternatives is equal to the ratio of the exponential of the observed utility index for alternative i to the sum of the exponentials of the observed utility indices for all J alternatives including the ith alternative.

The model can be estimated using maximum likelihood techniques. The parameters to be estimated are the weights β of the attributes in the utility function. Let us say X consists of K attributes, and one of the attributes is the price attribute p. Lancsar (2004) gives the marginal willingness to pay for one attribute k, and the willingness to pay for the whole commodity (or service) in question, resulting from all attributes, as follows:

$$MWTP_k = \frac{\frac{dV}{dX_k}}{-\frac{dV}{dp}} = \frac{\beta_k}{-\beta_p}$$

$$WTP = \sum_{k=1}^{K} \frac{\beta_k}{\beta_p} (\Delta X_k)$$

Similar to CVM, the Choice Experiment methodology has its critics. CE shares the same potential errors and biases with CVM and any other stated preference method, such as sequencing effects, elicitation effects, information effects, hypothetical bias and strategic bias, all of which were mentioned in the previous section. Cummings and Taylor (1999), List (2001), List et al. (2006), Blumenschein et al. (2008) and Savage and Waldman (2008) propose methods for minimizing bias in Choice Experiments. There are also additional issues related with CE that need to be considered before it is put into practice. CE estimates the marginal value of the attributes and presumes that the value of the entire commodity/service equals the aggregate of the values of the attributes. It is questionable that this assumption is valid. In fact, there are studies which find that the WTP estimates of Choice Experiments are considerably larger than the estimates of the Contingent Valuation Method (Maynard, 1996). Moreover, CE methodology is sensitive to design. The choice of alternatives, levels, choice sets in the design of the experiment can have an impact on the resulting estimates. If the respondents are given too many alternatives with varying attributes and levels, fatigue may cause them to make unsound choices. Also, there is the possibility of correlation between the choices made by the same individual due to repeated choice sets (Louviere, Hensher and Swait, 2000). These are important points of consideration when designing and using Choice Experiments.

On the other hand, CE method does offer advantages. For one, CE is able to break down a good or service into its attributes and measure the trade-offs between the attributes, as mentioned before. If one of these attributes is selected to be price, then CE can calculate the marginal value of changes in each attribute. For another, the CE approach determines the levels of attributes of each alternative offered exogenously and avoids collinearity problems by offering non-existing alternatives. For instance, in the case of mobile service improvement, speed and quality attributes change independently in the hypothetical alternatives of a Choice Experiment, whereas they often vary together almost perfectly in the real market. Hence, the CE approach is able to extract the impact of speed and quality separately. The last and equally important advantage of CE is that it is a better simulation of real-world transactions than CVM. In a CVM study, survey takers are presented with a hypothetical situation, so their responses and the WTP estimate of the study depend on how accurate the information in this presentation is. In a CE study, respondents are given alternatives and asked to make a choice, like they do in reality. The fact that respondents are reminded about substitutes and complements improves the reliability of the WTP figure estimated by CE.

2.4.3 Review of Selected Consumer Studies on the Value of Broadband Services (Fixed & Mobile)

Estimating consumer preferences for the attributes of telecommunications services has been a topic of interest among researchers since the advent of broadband internet in the 1990s. Earlier studies focused on fixed broadband services, while the focus has shifted towards mobile services since the 2010s as mobile technologies have caught up and overtaken fixed technologies. A number of notable stated preference studies that estimate consumers' valuations for telecom services and their attributes have been completed to date.

2.4.3.1 Consumer Studies for Fixed Broadband Services

Madden and Simpson (1997) were among the first to carry out research in this area. They used data obtained from a national survey of households in Australia in order to determine the willingness of households to subscribe to a broadband network. The fact that broadband services were not currently available at that time was a complication for their study. Out of 1,010 households surveyed, 598 provided usable data. The authors employed maximum likelihood estimation for a logit model, and found that the effects of the installation fee and income on the probability of subscription were statistically significant, whereas the effect of monthly fee was not. Other determinants for the probability of subscription were the size of the household, the age of the household head and whether the head was employed in a blue-collar occupation.

Ida and Kuroda (2006) studied the Japanese market for broadband services such as ADSL, CATV (cable television internet) and FTTH (fibre to the home). They employed a discrete choice analysis with a nested logit model on a data set of 1,013 observations. They showed that a nested choice structure of narrowband (dial-up, ISDN) versus broadband (ADSL, CATV, FTTH) is the best model fit because of the sign conditions of price and speed variables, their statistical significance and degrees of fitness. They also showed that the own-price elasticity of ADSL is inelastic, while the figures for CATV and FTTH are elastic, concluding that the ADSL market is independent of other services.

Rosston et al. (2010) produced the most comprehensive CE study on the broadband internet market in the USA, and for the first time introduced the effects of attributes. The authors employed discrete choice analysis to estimate the marginal WTP for improvements in eight internet service characteristics: cost, reliability, speed, laptop mobility, movie rental, priority, telehealth and videophone. The data was from a nationwide survey conducted with 6,271 respondents in late 2009 and early 2010. The results implied that reliability and speed were important characteristics of internet service. Estimated MWTPs were 20 USD per month for more reliable service, 45 USD for an improvement in speed from slow to fast, and 48 USD for an improvement in speed from slow to very fast. MWTPs for the other attributes were 6 USD or less. Valuations for broadband internet were larger for experienced households, and there was an estimated two- to three-fold increase in consumer surplus between 2003, when a similar study was conducted, and 2010.

Carare et al. (2015) focused on measuring the WTP for broadband of non-adopters in the USA. They reported that 28% of American households did not have a broadband subscription as of October 2012, and set out to identify the determinants of broadband adoption. The study used a survey of 15,082 households conducted in 2011. Approximately two thirds of the respondents stated that they would not consider subscribing at any price, for reasons such as a lack of skills or a lack of a computer or other device. The authors found that, conditional on the available household characteristics, including education and the presence of children, the likelihood of broadband adoption increased with higher levels of income.

2.4.3.2 Consumer Studies for Mobile Broadband Services

The term ‘mobile broadband’ was born with the advent of 3G technology in the 2000s. Since then, there have been a number of empirical studies evaluating consumer preferences for mobile broadband services, both 3G and 4G, and for related attributes.

Kim (2005) estimated consumer preferences for IMT-2000 (3G) services, focusing on service upgrades including video telephony, global roaming and multimedia mobile internet applications. Using a survey of 250 respondents from Seoul, South Korea, Kim found large variations in consumer valuation of 3G service upgrades. The results indicated that consumers place a higher value on video telephony than on multimedia mobile internet and global roaming services.

Shin et al. (2011) carried out a similar conjoint analysis for mobile service consumption in Uzbekistan. Their primary aim was to identify the demand for mobile number portability (MNP), which refers to consumers’ right to keep their mobile numbers while switching between mobile service providers. Other attributes estimated in the study were price, call and service quality, discount calls within the same network, and the mobile network operator company. Using 115 responses for their survey, the authors found that price and quality were the most valuable attributes, while subscribers did not consider MNP to be an important service upgrade.

The first study evaluating consumers’ preferences for 4G technology was by Kwak and Yoo (2012). It involved 500 person-to-person interviews held in Seoul, South

Korea, in which a CE was used in order to evaluate the MWTP for the following 4G attributes: data rates, quality of communications service, number of broadcasting channels, video-on-demand (VOD) service and supplementary services. The authors found that "consumers were interested in 4G and were quite prepared to pay for 4G services". Estimated per-month figures for MWTP were 4.03 USD for improved communication service, 0.06 USD for an additional broadcasting channel, 1.75 USD for VOD and 1.45 USD for supplementary services.

Klein and Jakopin (2014) took a different approach in their conjoint analysis study, attempting to investigate bundling of mobile telecommunication services. As mobile use has spread and competition in the mobile sector has intensified, mobile operators have aimed to gain competitive edge by bundling services together, including, but not limited to, minutes for talking, text messaging, internet access, and even financing for a mobile device. The authors collected data via an online survey among German consumers, and carried out their analysis using 116 responses out of a total of 355 surveyed. The results indicated that pricing was the most important attribute in a service bundle, followed by minutes included and internet access. Text messaging was calculated to be the least important attribute. To account for the accuracy of the estimated WTP figures, both linear calculation and curve fitting were conducted for the price parameter, with no significant change in results.

The current study is the first to estimate the importance to consumers of being able to use their local mobile package while travelling abroad (unrestrained roaming, in short). An increasing number of people around the world have travelling routines, and the excessive fees on mobile roaming can be minimised or eliminated through regulation (Sutherland, 2012). Furthermore, this study is an update on the consumer studies evaluating 4G, as we include in our attribute list the top data rates currently available with the most advanced 4G technologies. This will shed light on the extent of the consumer demand for ever-faster mobile data rates.

Chapter 3

CHOICE EXPERIMENT DESIGN

3.1 Introduction

The experiment design is an important part of choice analysis, as much depends on whether the experiment is designed properly. Poorly designed experiments will lead to erroneous parameter estimations with inaccurate statistical significance, leading to defective policy implications. Hensher et al. (2005) lay out the steps of a proper CE design as follows:

a. Problem refinement
b. Stimuli refinement
c. Experimental design consideration
d. Generating experimental design
e. Allocating attributes to design columns
f. Generating choice sets
g. Randomizing choice sets
h. Constructing survey instrument

In this chapter, we take on each step of a CE design and end up with the final design we use in this dissertation. In the sections following, we discuss the important design considerations at every step of the design.

3.2 Problem Refinement

The first step in the CE design is to better understand the problem to be solved. This step was performed via two focus groups held in January 2015. Participants in the focus groups first filled a questionnaire to extract information on their background, current mobile service, frequency and purpose of mobile use. Then we moved on to a casual discussion of what problems they currently faced with their service, what else they would like to do with their mobile service which they cannot do now, and what improvements they expect from their mobile service provider.

The focus groups have confirmed there is a widespread discontent about the speed of the mobile internet offered in the market. People are aware that they can have faster mobile internet with the 4G technology, which is implemented in many countries but not in Northern Cyprus. It is a matter of frustration for most respondents that there is no immediate plan of the government to introduce 4G in the near future. They, however, are not aware what other benefits 4G will provide them. People also demand Mobile Number Portability (MNP). This is the right to keep your mobile number as it is while switching your service provider. However, when asked how much they would be willing to pay for MNP, they say they would not be willing to pay as they consider MNP to be a consumer right. Another matter of concern is the excessive roaming charges that mobile users have to pay when travelling abroad. Almost all of the focus group participants report that they frequently travel to Turkey for business, for leisure, for shopping or simply for taking a flight to another destination. Although several roaming packages and special rates have been introduced by service providers in recent years, people would like to be able to use their home mobile plan when in Turkey as well. Similarly focus groups participants expressed discontent with the fact that they cannot use their mobile service in South Cyprus, due to the current political problem. Furthermore, we asked the participants whether they would be interested in and willing to pay for video telephony and video-on-demand services (previously studied in MC stated-preference research) offered by their mobile service provider. They were interested but not willing to pay, as these services are already offered by third-party applications, and mostly free of charge. Last but not the least, participants stated they would like the data caps on mobile internet to be removed so that they could use their mobile service for their home internet connection as well. They are discontent with the state-run ADSL internet service, which is the only fixed broadband service available in North Cyprus. The system lacks capacity, the infrastructure is old and troubled, and, besides, ADSL technology is limited to a maximum speed of 8 Mbps. The faster cable and fibre technologies would be too costly to introduce, so the only remaining option is wireless connection. If mobile operators offer unlimited internet use instead of imposing data caps, many people would be willing to replace their fixed home connection with a mobile subscription.

3.3 Stimuli Refinement

Stimuli refinement involves identifying the proper attributes and the attribute levels for the CE study, and it is performed with the information obtained in the focus groups. The attributes to be picked should represent the important issues which consumers consider when making a choice regarding their mobile service. Choosing the right attributes leads to choosing the right model to estimate. It is also essential to select realistic attribute levels, which people face in the real market.

The discussions in the focus groups have led us to pick 5 attributes as the improvements to be offered in a new mobile service. The following table provides the list of the attributes.

Table 3.1: List of Attributes

Attribute	**Description**
Internet speed	Speed of the mobile internet provided by the mobile service.
Internet limit	Limit for the amount of data which can be downloaded using the mobile internet provided by the mobile service.
Quality	Quality of voice conversation and mobile internet connectivity (as to whether freezing/slowing/disconnection occur).
Unrestrained use in Turkey	Speaking and internet use in Turkey with TRNC number without roaming costs (using same plan as in TRNC)
Unrestrained use in South Cyprus	Speaking and internet use in South Cyprus with TRNC number without roaming costs (using same plan as in TRNC)
Cost	Additional monthly GSM cost per subscription

4G mobile communications technology enables very high speed mobile internet connectivity. 4G mobile internet has a minimum connection speed of 30 Mbit/s, and it is capable of providing speeds up to 300 Mbit/s. The 3G technology currently in use in TRNC provides an average speed of 3 Mbit/s. This means 4G mobile internet is 10 to 100 times faster than 3G mobile internet. Therefore, we pick "internet speed" to be our first attribute, and we assign 3 attribute levels: present speed, 10 times faster, and 100 times faster.

If 4G mobile internet service is offered with no data caps, consumers state that it can be used for home internet connection as well, so that people may opt not to purchase a separate home internet service. Therefore, "internet limit" is our next attribute, with 2 attribute levels: limited/meter-rate, unlimited.

Another advantage of the 4G technology when compared with 3G, is that 4G is better in quality, in other words 4G provides a higher quality voice conversation and mobile internet connection capability. 4G users never experience any freezing or disconnection while speaking on their mobile phone or surfing the internet. “Quality” is our third attribute, and we assign 2 levels: present level, better quality.

The next attributes are unrestrained use of mobile services when in Turkey, and when in South Cyprus. Cyprus is a small island, and citizens of North Cyprus frequently travel to two destinations: Turkey and South Cyprus. They travel for business, for entertainment, for shopping, or simply to take a flight to a third destination. However much they travel, they cannot use their home mobile subscription freely, so they end up paying extra roaming fees or purchasing another local mobile number. If their mobile service offered unrestrained use in Turkey and in South Cyprus, which is possible through bilateral roaming regulation between governments, people could use their home minutes and data plans in these destinations. We split the attribute for unrestrained use in Turkey and South Cyprus into two attributes, because a separate bilateral roaming regulation is required for each destination. For each attribute, we assign 2 levels: non-available, and available.

We do not find strong justification to include in our study the other attributes mentioned in the literature. The concept of broadcasting channels (Kwak and Yoo, 2012) was difficult for most participants to grasp, and its impact for the consumer is already captured by the attributes of internet speed and quality. Video telephony (Kim, 2005) and VOD (Kwak and Yoo, 2012) are already offered by third-party applications, and mostly free of charge, so people are not willing to pay extra for these services. Mobile internet and global roaming (Kim, 2005) are already available in today’s standard subscriptions, and MNP (Shin et al., 2011), though currently not available in North Cyprus, is believed to be a consumer right and likely to receive too many ‘protest zero’ valuations. Service bundling (Klein and Jakopin, 2014) is not the focus of this paper, since we are interested in improvements in mobile services, rather than the bundling of existing services.

The last attribute we add to our list is the “cost” attribute which refers to the additional monthly cost for the improved mobile service. In order to achieve reasonable accuracy when calculating willingness-to-pay figures, we assign 4 levels: 20, 40, 60 and 80 Turkish Liras.

The final list of attributes and attribute levels are given in the following table. A blocking variable with 8 levels is added to the table in order to divide the treatment combinations in the CE study into 8 versions, so that each individual participant of the CE study will be given fewer combinations to make choices from.

Table 3.2: Final List of Attributes and Attribute Levels

Attribute	**Description**	**No of Levels**	**Levels**
Internet speed	describes mobile internet speed	3	Present speed (3 Mbit/s)
			10 times faster (30 Mbit/s)
			100 times faster (300 Mbit/s)
Internet limit	describes unlimited use of mobile internet without additional cost	2	Limited/meter-rate (high extra costs with over use)
			Unlimited (unlimited use – no extra costs)
Quality	describes the quality of voice conversation and mobile internet connectivity (as to whether freezing/slowing/disconnection occur)	2	Present level
			Better quality

Use in Turkey w/out roaming cost	Speaking and internet use in Turkey with TRNC number without roaming costs (using same plan as in TRNC)	2	No
			Yes
Use in South Cyprus w/out roaming cost	Speaking and internet use in South Cyprus with TRNC number without roaming costs (using same plan as in TRNC)	2	No
			Yes
Cost	Additional monthly GSM cost per subscription	4	20 TL
			40 TL
			60 TL
			80 TL
Blocking variable	Included in order to divide the treatment combinations into 8 versions	8	Block 1
			Block 2
			Block 3
			Block 4
			Block 5
			Block 6
			Block 7
			Block 8

3.4 Experimental Design Consideration

Choice Experiments, as the name suggests, require decision makers to make some type of choice in order to extract information about their preferences. Therefore a CE should present the respondent with choice sets (in other words, treatment combinations), each with at least two alternative to choose from. It is at the heart of experiment design to generate the treatment combinations to be used in the CE.

There are various classes of designs which can be used in a Choice Experiment. The most general class of design available to the researcher is the *full factorial design*. A full factorial design is a design in which all possible combinations of the attribute alternatives are used. By this way, the decision maker reveals his preferences for all possible combinations and the researcher is able to fully observe his behaviour. However, using all possible treatment combinations makes the CE study very lengthy and time-consuming, placing a significant level of cognitive burden on the respondents (we would require $(3 * 2^4 * 4)^2$ choice questions in total for this study). Moreover, as the number of attributes to be used increases, the size of a full factorial design grows exponentially. Therefore, the researcher almost always needs to find ways to reduce the size of the experimental design.

In order to reduce the size of the experimental design, we use a fraction of the total number of treatment combinations available. A design using a fraction of the treatment combinations is called a *fractional factorial* design. In forming such a design we could randomly choose which combinations to use, but this would give us a statistically inefficient or sub-optimal design. Instead, we need a design which maintains *orthogonality*. Orthogonality means all attributes are statistically independent of one another – that there are zero correlations between attributes. Therefore, an orthogonal design has zero correlations between the columns of the design.

There are 3 steps to take in order to generate the smallest possible orthogonal design for an experiment. First, we need to determine the main effects and the selections of interaction effects to be tested. Main effects are the direct independent effects of each attribute on the choice to be made. Interaction effects, on the other hand, are the effects obtained when two or more attributes are combined, but not observed when each of the attributes are estimated separately. The second step is taking care of the minimum degrees of freedom required for model estimation. The degrees of freedom are the number of observations in a sample minus the number of independent constraints, which are the β-parameters we estimate in our model. Since we need at least one degree of freedom for model estimation, we require the number of observations (treatment combinations) to be larger than the number of parameters to be estimated over all alternatives. The third and last step is finding the number of treatment combinations which is above this minimum and which will provide for design orthogonality. As noted in the second step, the minimum required number of observations is the number of parameters plus one, but more treatment combinations need to be included most of the time in order to have an orthogonal design. Once the steps described above are fulfilled, the smallest possible orthogonal design can be generated.

3.5 Generating Experimental Design

Taking on the task of generating an orthogonal fractional factorial design for our experiment, let us first revisit our table of attributes with attribute levels coded by *design coding*:

Table 3.3: Final List of Attributes with Design Coding

Attribute	**Description**	**No of Levels**	**Levels**	**Design Coding**
Internet speed	Describes mobile internet speed	3	Present speed	0
			10 times faster	1
			100 times faster	2
Internet limit	Describes unlimited use of mobile internet without additional cost	2	Limited/meter-rate	0
			Unlimited	1
Quality	Describes the quality of voice conversation and mobile internet connectivity	2	Present level	0
			Better quality	1
Use in Turkey w/out roaming cost	Speaking and internet use in Turkey with TRNC number without roaming costs (using same plan as in TRNC)	2	No	0
			Yes	1
Use in South Cyprus w/out roaming cost	Speaking and internet use in South Cyprus with TRNC number without roaming costs (using same plan as in TRNC)	2	No	0
			Yes	1
Cost	Additional monthly GSM cost per subscription	4	20 TL	0
			40 TL	1
			60 TL	2
			80 TL	3
Blocking variable	Included in order to divide the treatment combinations into 8 versions	8	Block 1	0
			Block 2	1
			Block 3	2
			Block 4	3
			Block 5	4
			Block 6	5
			Block 7	6
			Block 8	7

In our experiment, we will be interested in main effects only – that is the effects of our attributes on the choice of mobile service. If possible, we would also like to maintain the main effects to be uncorrelated with a selection of interaction effects, which could be significant, so that our estimations for the main effects remain unconfounded.

We require at least one degree of freedom for model estimation, so the number of observations should exceed the number of parameters to be estimated. Since our experiment has “unlabelled” alternatives with linear main effects, the number of parameters to be estimated are the 7 β-parameters of the 7 attributes. Therefore, the the minimum number of profiles (treatment combinations) required is 8.

We use the Orthogonal Design feature of the statistical software package SPSS 20.0 in order to generate the experiment design. A design with 8 profiles would be sufficient for the requirement of the degrees of freedom, and 16 profiles would provide for orthogonality. However, in order to be able to extract more information about people’s preferences, we select the minimum number of cases to generate as 32, and hence we generated the following orthogonal design with 32 profiles.

Table 3.4: Orthogonal Design Generated with 32 Profiles

Profiles (treatment combinations)	A	B	C	D	E	F	G
1	0	0	1	0	1	0	5
2	2	1	0	1	0	2	5
3	1	0	0	1	0	3	4
4	0	0	1	0	0	2	4
5	1	0	0	1	1	1	5
6	0	0	0	1	1	0	6
7	1	0	1	1	1	3	1
8	2	0	0	0	0	1	3
9	0	0	1	1	0	0	3

10	0	1	1	1	1	3	3
11	2	0	0	0	1	3	2
12	0	1	1	1	0	1	2
13	2	1	1	1	0	0	1
14	0	0	1	1	1	2	2
15	0	1	0	1	0	3	6
16	0	0	0	0	1	2	1
17	0	1	1	0	1	1	4
18	1	1	0	0	1	2	3
19	2	1	0	1	1	0	4
20	0	0	0	0	0	0	0
21	1	1	0	0	0	0	2
22	1	0	1	1	0	1	0
23	1	1	1	0	0	2	6
24	0	1	1	0	0	3	5
25	0	1	0	0	0	1	1
26	0	1	0	1	1	1	7
27	2	0	1	0	0	3	7
28	2	1	1	1	1	2	0
29	2	0	1	0	1	1	6
30	1	1	1	0	1	0	7
31	0	0	0	1	0	2	7
32	0	1	0	0	1	3	0

It should be noted that attribute A consists of 3 levels, attributes B, C, D, E consist of 2 levels, attribute F consists of 4 levels, and attribute G consists of 8 levels. Attribute G will be used as a blocking variable in order to divide the orthogonal design into eight 4-profile blocks. The eight blocks will constitute the eight versions of the survey, and therefore, each individual taking the survey will receive only 4 of the thirty two profiles.

3.6 Allocating Attributes to Design Columns

One way to assign attributes to design columns is to ensure interaction effects of concern, as mentioned earlier, remain unconfounded with the main effects. Therefore we produce the table of two-way interaction effects, and the correlation matrix of the main effects and the interaction effects.

Appendix A.1 displays the two-way interaction effects, calculated by multiplying the orthogonal codes of the pair of main effects present in each interaction.

Appendix A.2 displays the Correlation Matrix of the main effects and the interaction effects. At the first glance, it should be noted that all the main effects have zero correlations with each other. This is the requirement for orthogonality. Next, we look into the correlations of the two-way interactions with the main effects. We note that none of the two-way interactions (AB, AC, AD, AE, AE, AF, AG, BC, BD, BE, BF, BG, CD, CE, CF, CG, DE, DF, DG, EF, EG, FG) are unconfounded with all the main effects. This is due to the number of attribute levels and the number of profiles chosen for the experiment design. We could reach to a design where some interaction effects are unconfounded with the main effects, if we increased the number of profiles, however this would add to the complexity of the study. Since our priority is to study the main effects, and since we do not consider the interaction effects to be too significant to disrupt our results, we opt to keep the current experiment design for purposes of simplicity.

We decide to ignore interaction effects in our design, so we can allocate attributes to the design columns as follows: A for Speed, B for Limit, C for Quality, D for Turkey (i.e. Unrestrained use in Turkey), E for South Cyprus (ie. Unrestrained use in South Cyprus), F for Cost, G for Blocking. This selection allows the right number of levels for all the attributes.

Finally, we depict in Table 3.5 the orthogonal plan for the experiment with attribute columns labelled properly. It should be noted that we split the Speed attribute into two columns: “Fast Speed” and “Very Fast Speed”. This is done in order to accommodate the non-linear effects in the levels of the Speed attribute.

Table 3.5: Orthogonal Plan with Columns Labelled

	Speed Fast	Speed Very Fast	Limit	Quality	Turkey	South Cyprus	Add. Cost	Blocking
Profile	A1	A2	B	C	D	E	F	G
1	0	0	0	1	0	1	0	5
2	0	1	1	0	1	0	2	5
3	1	0	0	0	1	0	3	4
4	0	0	0	1	0	0	2	4
5	1	0	0	0	1	1	1	5
6	0	0	0	0	1	1	0	6
7	1	0	0	1	1	1	3	1
8	0	1	0	0	0	0	1	3
9	0	0	0	1	1	0	0	3
10	0	0	1	1	1	1	3	3
11	0	1	0	0	0	1	3	2
12	0	0	1	1	1	0	1	2
13	0	1	1	1	1	0	0	1
14	0	0	0	1	1	1	2	2
15	0	0	1	0	1	0	3	6
16	0	0	0	0	0	1	2	1
17	0	0	1	1	0	1	1	4
18	1	0	1	0	0	1	2	3
19	0	1	1	0	1	1	0	4
20	0	0	0	0	0	0	0	0
21	1	0	1	0	0	0	0	2
22	1	0	0	1	1	0	1	0
23	1	0	1	1	0	0	2	6
24	0	0	1	1	0	0	3	5
25	0	0	1	0	0	0	1	1
26	0	0	1	0	1	1	1	7
27	0	1	0	1	0	0	3	7
28	0	1	1	1	1	1	2	0
29	0	1	0	1	0	1	1	6
30	1	0	1	1	0	1	0	7
31	0	0	0	0	1	0	2	7
32	0	0	1	0	0	1	3	0

3.7 Generating Choice Sets

Next step in the experiment design is generating the choice sets. We take on the attribute based strategy with the shifting technique to produce the choice sets (Bunch et al., 1996). The profiles or treatment combinations shown in Table 3.5 constitute the Service A in the choice sets. We generate the Service B by "shifting" the profiles of Service A. Using modular arithmetic, we add to the profiles of A:

- 1 (mod 2) for 2-level attributes
- 1 or 2 (mod 3) for 3-level attributes
- 1, 2 or 3 (mod 4) for 4-level attributes

in order to generate the profiles of Service B.

Table 3.6 shows the orthogonal plan sorted by the blocking variable. This plan depicts the profiles for Service A in the choice sets. Appendix A.3 shows the Service B profiles generated by "shifting" the Service A profiles. It should be noted that there are 6 possible plans for Service B: generated by shifting the 3-level attribute by 1 unit and 2 units, and the 4-level attribute by 1 unit, 2 units and 3 units.

Table 3.6: Profiles for Service A Sorted by Blocking Variable

		Service A					
Profiles	G	A	B	C	D	E	F
	Blocking	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost
20	0	0	0	0	0	0	0
22	0	1	0	1	1	0	1
28	0	2	1	1	1	1	2
32	0	0	1	0	0	1	3
7	1	1	0	1	1	1	3
13	1	2	1	1	1	0	0
16	1	0	0	0	0	1	2
25	1	0	1	0	0	0	1
11	2	2	0	0	0	1	3

12	2	0	1	1	1	0	1
14	2	0	0	1	1	1	2
21	2	1	1	0	0	0	0
8	3	2	0	0	0	0	1
9	3	0	0	1	1	0	0
10	3	0	1	1	1	1	3
18	3	1	1	0	0	1	2
3	4	1	0	0	1	0	3
4	4	0	0	1	0	0	2
17	4	0	1	1	0	1	1
19	4	2	1	0	1	1	0
1	5	0	0	1	0	1	0
2	5	2	1	0	1	0	2
5	5	1	0	0	1	1	1
24	5	0	1	1	0	0	3
6	6	0	0	0	1	1	0
15	6	0	1	0	1	0	3
23	6	1	1	1	0	0	2
29	6	2	0	1	0	1	1
26	7	0	1	0	1	1	1
27	7	2	0	1	0	0	3
30	7	1	1	1	0	1	0
31	7	0	0	0	1	0	2

At this point, let us investigate our design for the desired properties of an efficient experimental design: orthogonality, level balance and minimal overlap. Our design fulfills “orthogonality” because the profiles of Service A are generated as an orthogonal design in the first place, and the shifting technique maintains the orthogonality of Service B. This can be verified by adding up orthogonal codes of columns to find each column sums up to zero. The “level balance” property refers to having all the attribute levels show up the same number of times in the profiles. In our design, each level appears 16 times for the 2-level attributes, 8 times for the 4-level attribute, and 8 times for the two non-zero levels of the 3-level attribute (note that the number of profiles is not divisible by 3, so this is the best that can be done for level balance). Last, our design has also “minimal overlap” property as the shifting technique to generate Service B ensures that no attribute is used more than once in each choice set.

A fourth desirable property for design efficiency is “utility balance”. Utility balance is maintained by reducing the utility gap among Service A and Service B in each choice set. If the expected utility of the respondents from the alternatives is closer to each other, the analyst is able to extract more information from the Choice Experiment. The last column titled “Code-sum difference” in Appendix A.3 is included in order to determine which of the 6 scenarios for Service B produce better utility balance, and hence we can choose the most preferable Service B to use in our study.

Code-sum difference, as the name suggests, is the absolute difference between the sum of codes in Service A and the sum of codes in Service B, for each choice set. The higher the code for each attribute, the higher is the expected utility level from that attribute, except the cost attribute. Therefore we add the negative of the level of the cost attribute when calculating code-sums. By this way, we also make sure the higher the code-sum for each alternative, the higher is the expected utility level for that alternative. Thus, the code-sum difference between Services A and B gives us the utility gap between A and B: the higher the code-sum difference the higher the utility gap, and the lower the code-sum difference the lower the utility gap.

The above information tells us to look for the minimum code-sum differences in order to have the best utility balance. Looking at Appendix A.3, we see that the Service B in scenario 5 produces the minimum code-sum differences.

We choose to continue with the Service B in scenario 5. Table 3.7 depicts the final versions of Service A and Service B in design codes. Table 3.8 depicts again Service A and Service B in labelled attribute levels.

Table 3.7: Final Version of Service A and Service B in Design Codes

		Service A						Service B						
Profiles	G	A	B	C	D	E	F	A	B	C	D	E	F	Code-sum difference
	Blocking	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	
20	0	0	0	0	0	0	0	1	1	1	1	1	3	0,5
22	0	1	0	1	1	0	1	2	1	0	0	1	0	2,5
28	0	2	1	1	1	1	2	0	0	0	0	0	1	4,5
32	0	0	1	0	0	1	3	1	0	1	1	0	2	2,5
7	1	1	0	1	1	1	3	2	1	0	0	0	2	0,5
13	1	2	1	1	1	0	0	0	0	0	0	1	3	8,5
16	1	0	0	0	0	1	2	1	1	1	1	0	1	4,5
25	1	0	1	0	0	0	1	1	0	1	1	1	0	4,5
11	2	2	0	0	0	1	3	0	1	1	1	0	2	1,5
12	2	0	1	1	1	0	1	1	0	0	0	1	0	0,5
14	2	0	0	1	1	1	2	1	1	0	0	0	1	0,5
21	2	1	1	0	0	0	0	2	0	1	1	1	3	1,5
8	3	2	0	0	0	0	1	0	1	1	1	1	0	3,5
9	3	0	0	1	1	0	0	1	1	0	0	1	3	3,5
10	3	0	1	1	1	1	3	1	0	0	0	0	2	1,5
18	3	1	1	0	0	1	2	2	0	1	1	0	1	2,5
3	4	1	0	0	1	0	3	2	1	1	0	1	2	4,5
4	4	0	0	1	0	0	2	1	1	0	1	1	1	4,5
17	4	0	1	1	0	1	1	1	0	0	1	0	0	0,5
19	4	2	1	0	1	1	0	0	0	1	0	0	3	8,5

1	5	0	0	1	0	1	0	1	1	0	1	0	3	3,5
2	5	2	1	0	1	0	2	0	0	1	0	1	1	0,5
5	5	1	0	0	1	1	1	2	1	1	0	0	0	2,5
24	5	0	1	1	0	0	3	1	0	0	1	1	2	2,5
6	6	0	0	0	1	1	0	1	1	1	0	0	3	3,5
15	6	0	1	0	1	0	3	1	0	1	0	1	2	2,5
23	6	1	1	1	0	0	2	2	0	0	1	1	1	2,5
29	6	2	0	1	0	1	1	0	1	0	1	0	0	0,5
26	7	0	1	0	1	1	1	1	0	1	0	0	0	0,5
27	7	2	0	1	0	0	3	0	1	0	1	1	2	1,5
30	7	1	1	1	0	1	0	2	0	0	1	0	3	5,5
31	7	0	0	0	1	0	2	1	1	1	0	1	1	4,5

Table 3.8: Final Version of Service A and Service B with Labelled Attribute Levels

		Service A						Service B					
Profiles	G	A	B	C	D	E	F	A	B	C	D	E	F
	Blocking	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost
20	0	Present speed	Limited	Present level	No	No	20 TL	10 times faster	Unlimited	Better quality	Yes	Yes	80 TL
22	0	10 times faster	Limited	Better quality	Yes	No	40 TL	100 times faster	Unlimited	Present level	No	Yes	20 TL
28	0	100 times faster	Unlimited	Better quality	Yes	Yes	60 TL	Present speed	Limited	Present level	No	No	40 TL

32	0	Present speed	Unlimited	Present level	No	Yes	80 TL	10 times faster	Limited	Better quality	Yes	No	60 TL
7	1	10 times faster	Limited	Better quality	Yes	Yes	80 TL	100 times faster	Unlimited	Present level	No	No	60 TL
13	1	100 times faster	Unlimited	Better quality	Yes	No	20 TL	Present speed	Limited	Present level	No	Yes	80 TL
16	1	Present speed	Limited	Present level	No	Yes	60 TL	10 times faster	Unlimited	Better quality	Yes	No	40 TL
25	1	Present speed	Unlimited	Present level	No	No	40 TL	10 times faster	Limited	Better quality	Yes	Yes	20 TL
11	2	100 times faster	Limited	Present level	No	Yes	80 TL	Present speed	Unlimited	Better quality	Yes	No	60 TL
12	2	Present speed	Unlimited	Better quality	Yes	No	40 TL	10 times faster	Limited	Present level	No	Yes	20 TL
14	2	Present speed	Limited	Better quality	Yes	Yes	60 TL	10 times faster	Unlimited	Present level	No	No	40 TL
21	2	10 times faster	Unlimited	Present level	No	No	20 TL	100 times faster	Limited	Better quality	Yes	Yes	80 TL
8	3	100 times faster	Limited	Present level	No	No	40 TL	Present speed	Unlimited	Better quality	Yes	Yes	20 TL
9	3	Present speed	Limited	Better quality	Yes	No	20 TL	10 times faster	Unlimited	Present level	No	Yes	80 TL
10	3	Present speed	Unlimited	Better quality	Yes	Yes	80 TL	10 times faster	Limited	Present level	No	No	60 TL
18	3	10 times faster	Unlimited	Present level	No	Yes	60 TL	100 times faster	Limited	Better quality	Yes	No	40 TL
3	4	10 times faster	Limited	Present level	Yes	No	80 TL	100 times faster	Unlimited	Better quality	No	Yes	60 TL

4	4	Present speed	Limited	Better quality	No	No	60 TL	10 times faster	Unlimited	Present level	Yes	Yes	40 TL
17	4	Present speed	Unlimited	Better quality	No	Yes	40 TL	10 times faster	Limited	Present level	Yes	No	20 TL
19	4	100 times faster	Unlimited	Present level	Yes	Yes	20 TL	Present speed	Limited	Better quality	No	No	80 TL
1	5	Present speed	Limited	Better quality	No	Yes	20 TL	10 times faster	Unlimited	Present level	Yes	No	80 TL
2	5	100 times faster	Unlimited	Present level	Yes	No	60 TL	Present speed	Limited	Better quality	No	Yes	40 TL
5	5	10 times faster	Limited	Present level	Yes	Yes	40 TL	100 times faster	Unlimited	Better quality	No	No	20 TL
24	5	Present speed	Unlimited	Better quality	No	No	80 TL	10 times faster	Limited	Present level	Yes	Yes	60 TL
6	6	Present speed	Limited	Present level	Yes	Yes	20 TL	10 times faster	Unlimited	Better quality	No	No	80 TL
15	6	Present speed	Unlimited	Present level	Yes	No	80 TL	10 times faster	Limited	Better quality	No	Yes	60 TL
23	6	10 times faster	Unlimited	Better quality	No	No	60 TL	100 times faster	Limited	Present level	Yes	Yes	40 TL
29	6	100 times faster	Limited	Better quality	No	Yes	40 TL	Present speed	Unlimited	Present level	Yes	No	20 TL
26	7	Present speed	Unlimited	Present level	Yes	Yes	40 TL	10 times faster	Limited	Better quality	No	No	20 TL
27	7	100 times faster	Limited	Better quality	No	No	80 TL	Present speed	Unlimited	Present level	Yes	Yes	60 TL
30	7	10 times faster	Unlimited	Better quality	No	Yes	20 TL	100 times faster	Limited	Present level	Yes	No	80 TL

31	7	Present speed	Limited	Present level	Yes	No	60 TL	10 times faster	Unlimited	Better quality	No	Yes	40 TL

3.8 Versions of Choice Sets

Profiles for the Service A and Service B in the choice sets are now final. The experiment design is divided into 8 blocks of 4 profiles each, therefore each survey respondent will be presented with 4 choice sets. These blocks constitute the versions of the CE study. Table 3.9 displays the 8 versions.

Table 3.9: Versions of the Choice Experiment

Profile	Version	Choice Set
20	1	1
22	1	2
28	1	3
32	1	4
7	2	1
13	2	2
16	2	3
25	2	4
11	3	1
12	3	2
14	3	3
21	3	4
8	4	1
9	4	2
10	4	3
18	4	4
3	5	1
4	5	2
17	5	3
19	5	4
1	6	1
2	6	2
5	6	3
24	6	4
6	7	1
15	7	2
23	7	3
29	7	4
26	8	1
27	8	2
30	8	3
31	8	4

3.9 Randomizing Choice Sets

Last but not the least step in CE design is randomizing the choice sets.

The need for randomizing occurs for two reasons. For one, there could be "learning effects" in a CE study. People's responses to the choice sets early in the experiment may be of poor quality since they are still learning how to relate the choice sets to reality. For two, there could be "fatigue effects" in a CE study. People's responses towards the end of the experiment may deteriorate because they get tired of answering the questions and would like to get to the end as quickly as possible. Therefore, if the choice sets for each version are presented to all the respondents in the same order, then the study will be prone to "order bias".

Completely randomizing the order of the choice sets is one option, however it would require too many versions of the survey and make the administration of the CE study very difficult. Instead, we duplicate each version of the survey by switching the order of the first two choice sets and the last two choice sets. For instance, for the survey version 1, we create two versions 1a and 1b. Version 1a, has the first two choice sets (20, 22) and the last two choice sets (28, 32). This order is reversed in version 1b; the first two choice sets are (28, 32) and the last two choice sets are (20, 22). The complete list of 16 randomized versions of the survey is given in Table 3.10.

Table 3.10: Complete List of Randomized CE Versions

Version	Choice Set	Profile	Version	Choice Set	Profile
1a	1	20	1b	1	28
1a	2	22	1b	2	32
1a	3	28	1b	3	20
1a	4	32	1b	4	22
2a	1	7	2b	1	16
2a	2	13	2b	2	25

2a	3	16	2b	3	7
2a	4	25	2b	4	13
3a	1	11	3b	1	14
3a	2	12	3b	2	21
3a	3	14	3b	3	11
3a	4	21	3b	4	12
4a	1	8	4b	1	10
4a	2	9	4b	2	18
4a	3	10	4b	3	8
4a	4	18	4b	4	9
5a	1	3	5b	1	17
5a	2	4	5b	2	19
5a	3	17	5b	3	3
5a	4	19	5b	4	4
6a	1	1	6b	1	5
6a	2	2	6b	2	24
6a	3	5	6b	3	1
6a	4	24	6b	4	2
7a	1	6	7b	1	23
7a	2	15	7b	2	29
7a	3	23	7b	3	6
7a	4	29	7b	4	15
8a	1	26	8b	1	30
8a	2	27	8b	2	31
8a	3	30	8b	3	26
8a	4	31	8b	4	27

3.10 Constructing the Survey Instrument

Finally, “Current Service” is added to every choice set as a third alternative in addition to Service A and Service B. This makes the CE study more realistic for the respondent, and enables her to relate the attributes of A and B to the current mobile service she is using. If she does not find the Services A and B attractive, she has the option of staying with her current service. The current service has the following attribute levels, for all the respondents:

1. Current service internet speed: Present speed (The only mobile technology currently available in TRNC is 3G)

2. Current service internet limit: Limited/meter-rate (Current GSM operators in TRNC have no plans or packages which offer unlimited mobile internet use)

3. Current service internet quality: Present level

4. Use in Turkey w/out roaming cost with current service: No

5. Use in South Cyprus w/out roaming cost with current service: No

6. Additional monthly cost: 0 TL (No additional cost because it's the current service)

Table 3.11 shows a sample choice set from the survey.

Table 3.11: A Sample Choice Set

Version 2a Choice Set 1

	Service A	Service B	Service C (Current Service)
Internet speed	10 times faster	100 times faster	Present speed
Internet limit	Limited	Unlimited	Limited
Quality (speaking and internet)	Better quality	Present level	Present level
Turkey w/out add.expenses	Yes	No	No
S.Cyprus w/out add.expenses	Yes	No	No
Additional monthly GSM cost	80 TL	60 TL	0 TL
Your Choice	[ ]	[ ]	[ ]

Chapter 4

SURVEY DESIGN AND ADMINISTRATION

4.1 Introduction

In the last chapter, we established the design for the choice experiment, and produced the choice questions to be included in the survey. In Chapter 4, we move on to the contents of the questionnaire and to the administration of the survey.

4.2 Survey Sections

The survey consists of 5 sections in total. Two of these sections are devoted to extracting the data for the CVM (Contingent Valuation Method) and the CE (Choice Experiment) studies. Two other sections collect background information about the respondents, regarding their mobile experience and their demographic characteristics. The last section is spared for the interviewer's use in order to rate the quality of the interview.

The first section is titled "Mobile Phone and Internet Use" and includes questions to gather data on the respondent's mobile experience. These questions collect information such as the type of mobile devices owned, the monthly amount paid for mobile services, the frequency of mobile internet use, the purposes for mobile internet use, and the type of mobile internet plan. These questions are followed by additional questions about the respondent's use of mobile services abroad. The survey specifically asks for the frequency of travel to Turkey and South Cyprus, and the respondent's desire to use her local plan in these two destinations.

The second section is the CVM section. This is where we directly ask the respondent to state her willingness to pay for 4G service. In this section, we first present the interviewee with a detailed description of what 4G is, and what benefits 4G has over 3G. This is done in order to ensure the interviewee is as informed as possible, when stating her WTP. The CVM question is asked in the 'payment ladder' format. In this format, the respondent is presented with a ladder of prices, and she is asked to mark the highest amount she would pay for 4G, and the first (lowest) amount she would not pay. The first stands for her minimum WTP, and the latter for her maximum WTP. Therefore, we obtain an interval where the observer's true WTP lies. It should be noted that the payment ladder approach is preferable to an open-ended question. In the open-ended elicitation technique, many respondents may prefer not to answer due to the lack of a benchmark, and also, some may answer strategically making this technique prone to strategic bias.

The next section is the Choice Experiment section. There are 16 different versions of this section as described in Chapter 3, section 3.9. Each respondent is given a set of 4 choice questions similar to that in Table 3.11. The interviewers are trained beforehand to assist the respondents with answering choice questions without affecting their responses.

The fourth section is titled "Demographic Questions" and this is where we extract the respondents' demographic characteristics. The information we gather include age, gender, education, employment and net monthly income.

The last section is for interviewer use only. The interviewer rates the interview on a scale of very poor to very good. The interviewer considers the concentration of the interviewee and the quality of her understanding of the survey, while doing the rating. A copy of the complete survey is given in Appendix B.

4.3 Sample Size

Orme (2006) suggests a rule of thumb to determine the minimum sample size required to study choice based data. According to this rule, the minimum number of respondents n can be calculated as follows:

$$\frac{nta}{c} > 500$$

where t is the number of choice sets answered by each respondent, a is the number of alternatives in every choice set not including the current alternative, and c is the largest number of levels in the attributes (for designs not considering interaction effects). In our case, 4 choice sets are given to each respondent, there are 2 alternatives in each choice set, and 4 is the largest number of levels in the attributes. The calculations lead to a figure of 250 as the minimum sample size required. Orme (2006) adds that a minimum of 300 respondents is advisable for quantitative studies, so we determine our sample size to be 320. Since we have 16 versions of the choice experiment, we allocate 20 respondents for each version.

Louviere et al. (2000) gives another method for calculating total sample size in a choice experiment:

$$n \geq \frac{(1-p)}{rpa^2} \Phi^{-1}\left(\frac{1+\alpha}{2}\right)$$

where p is the true choice probability (true population proportion), r is the number of choice sets that each individual respondent is given, $\Phi^{-1}(\cdot)$ is the inverse cumulative normal distribution function, and we wish to estimate the true population proportion within a per cent of the true value p with probability α or greater. Taking $p = 0.5$,

$r = 4$, $a = 10\%$ and $\alpha = 0.95$, we calculate $n \geq 96$. Therefore, our choice of 320 respondents is a satisfactory sample size.

4.4 Sampling Method

Once we decide on the sample size, the next task is to identify the relevant (target) population. The relevant population is determined by the objectives of the study. In our study, we aim to quantify the value of improvements in mobile services, so our target group is the users of mobile services. Therefore, we choose to admit respondents to our survey by one question: Do you purchase mobile service for personal use? In the case of North Cyprus, this amounts to an overwhelming majority of the total population above 18 years of age.

Next, we pick the sampling method, which we will use to choose the individuals to be included in the survey sample. According to Champ et al. (2003), there are two types of sampling techniques: non-probability sampling and probability sampling. Non-probability sampling refers to when there is no known probability that any member of the population will be included in the sample. We cannot use the sample's results to make statistical inferences for the population. Probability sampling, on the other hand, refers to when the probability of each individual being in the sample is known, so the results of the survey can be used to infer for the population.

Louviere et al. (2000) lists the 'probability sampling' methods as follows: choice based sampling (CBS), simple random sampling (SRS) and exogenously stratified random sampling (ESRS). CBS requires the observation of choices made by the population. It is mostly used in revealed preference studies, and not suitable for stated choice experiments. SRS is where a random sample is picked from the population, and all individuals in the population have the same chances of being selected to the sample. ESRS, on the other hand, divides the population into mutually exclusive strata, and performs random sampling within each stratum. The number of sample units to be chosen from each stratum is in proportion with the relative sizes of the strata.

In our study, we prefer to have a fair representation from all regions of North Cyprus. Therefore, we opt to use exogenously stratified random sampling (ESRS), with the strata being the 5 districts of North Cyprus. We use the latest census data (2013) to calculate the number of respondents to be picked from each district, as shown in Table 4.1.

Table 4.1: ESRS Sampling according to Districts

District	**Population**	**% of Total**	**Target number of respondents**
Lefkoşa	94,824	33%	106
Gazimağusa	69,741	24%	78
Girne	69,163	24%	77
Güzelyurt	30,037	10%	34
İskele	22,492	8%	25
Total	**286,257**	**100%**	**320**

4.5 Questionnaire Results

The survey was conducted in March 2015 by a professional polling firm, Prologue Consulting Ltd. A total of 320 individuals were interviewed in all five districts of North Cyprus. Random sampling was performed within each district, reflecting the characteristics of the population with reasonable accuracy.

In-person interviewing was used as the survey administration mode, because the concepts in the study are fairly complicated and respondents may need guidance in answering choice questions. The concepts and attributes were explained thoroughly in a document preceding the section containing the choice questions. As described in section 4.1, the survey included a section that elicits information from respondents about their experience with mobile services, and a section that collects demographic data. Table 4.2 below presents a summary of this data.

Table 4.2: Questionnaire Results

Variable	No. obs.	Mean / %	Std dev.	Min.	25th %tile	Median	75th %tile	Max.
Mobile exp. & travel data								
Mobile device ownership	320							
Regular mobile phone	68	21%						
Smart phone	283	88%						
Tablet	76	24%						
Laptop	144	45%						
Mobile subscription	320							
I have	320	100%						
I do not have	0	0%						
Mobile subs. expenditure (TL/month)	320	107.23	91.98	20	50	80	130	800
Frequency of mobile int.use	320							
Every day	221	69%						
Several times a week	61	19%						
Several times a month	4	1%						
Very rarely	3	1%						
Never	31	10%						
Purpose for mobile int. use	288							
Search engines	172	60%						
E-mail	100	35%						
Instant messaging	190	66%						
Voice over IP	97	34%						
Videophone	72	25%						
Social networking sites	255	89%						
News sites	175	61%						

Watching videos	118	41%						
Watching movies	66	23%						
Other mobile applications	84	29%						
Cloud computing	31	11%						
Mobile hotspot	41	14%						
Time spent using mob. int. (hrs/week)	289	24.58	19.77	2	10	20	35	140
Regularly travelling to	320							
Turkey	230	72%						
South Cyprus	185	58%						
Either Turkey/S.Cyp/both	276	86%						
Neither Turkey nor S.Cyp.	44	14%						
Demographic data								
County	320							
Girne	75	23%						
Güzelyurt	36	11%						
İskele	24	8%						
Lefkoşa	109	34%						
Mağusa	76	24%						
Age	320	33.75	10.68	18	26	31	40	63
Gender	320							
Female	156	49%						
Male	164	51%						
Marital status	320							
Married	171	53%						
Not married	149	47%						
Education	320							
Primary school	25	8%						
Secondary school	33	10%						
High shool / Vocation sch.	118	37%						
University (2-year)	55	17%						
University (4-year)	81	25%						
Graduate school (Master)	5	2%						
Graduate school (Doctor.)	3	1%						
Employment	320							

Employed	226	71%						
Unemployed/out of labour	94	29%						
Net monthly income (TL/month)	269	2,504.41	1,557.50	300	1,600	2,000	3,000	11,000

Chapter 5

CHOICE EXPERIMENT RESULTS

5.1 Revisiting the CE Model

As described in Chapter 2, CE methodology makes use of the random utility theory. An individual, when faced with an alternative i, derives a utility from this alternative as follows:

$$U_i = V_i + \varepsilon_i$$

The component V_i is observable to the researcher, and the random component ε_i is not. The observed component V_i is where the set of attributes that are observable and measurable reside. The simplest assumption for V_i would be that it is a linear function of the attributes, each of which is weighted by a unique weight to account for that attribute's marginal utility input. Using f as a generalized notation for functional form, but noting that the functional form can be different for each attribute, we can write V_i as:

$$V_i = \beta_{0i} + \beta_{1i}f(X_{1i}) + \beta_{2i}f(X_{2i}) + \beta_{3i}f(X_{3i}) + \cdots + \beta_{Ki}f(X_{Ki})$$

where X_{ki} represents the $k = 1$ to K attributes of alternative i, β_{ki} represents the weights of these attributes, and β_{0i} is a parameter that is not associated with any observed attribute, but represents the role of all unobserved sources of utility.

We treat each attribute in our study to be linear so that $f(X) = X$; we assume the random component of utility ε_i to be inclusive of all sources of variance from unobserved components of β and X, and also that ε_i is IID (independently and identically distributed). We end up with the multinomial logit (MNL) model:

$$U = ASC + \beta_{fast}X_{fast} + \beta_{veryfast}X_{veryfast} + \beta_{unlimited}X_{unlimited} + \beta_{quality}X_{quality} + \beta_{turkey}X_{turkey} + \beta_{southcyprus}X_{southcyprus} + \beta_{price}X_{price} + \varepsilon$$

The alternative-specific constant (ASC) represents the utility derived from the existing service, and it captures the real and psychological costs of switching to a new service. The attribute variables X, except for the price attribute, are binary variables taking on the value 1 when the attribute is present in the service and 0 if it is not present. It should also be noted that we split the attribute for mobile internet speed into two attributes: fast speed and very fast speed. This is because we would like to detect the non-linear impact of moving from the present speed (3 Mbps) to 10 times faster (30 Mbps), and also from 10 times faster (30 Mbps) to 100 times faster (300 Mbps).

As the form of the utility expression is identified, we turn to how an individual makes a choice in a CE. The individual faces $j = 1$ to J alternatives, where $J = 3$ in our survey. In order to make a choice, the individual will evaluate the utility she or he will derive for each alternative and pick the one with the highest utility. Putting this into notation, the probability that alternative i will be chosen is:

$$P_i = P\left(\left(U_i \geq U_j\right) \forall\, j \in j = 1, \dots, J; i \neq j\right)$$

Rearranging gives us:

$$P_i = P\left(\left(V_i + \varepsilon_i \geq V_j + \varepsilon_j\right) \forall\, j \in j = 1, \dots, J; i \neq j\right)$$

$$P_i = P\left(\left((\varepsilon_j - \varepsilon_i) \leq (V_i - V_j)\right) \forall\, j \in j = 1, \dots, J; i \neq j\right)$$

Since the left-hand side of the inequality is not observable, estimating the model requires picking up a probability distribution for the 'error term'. A popular distribution in discrete choice analysis is the extreme value type 1 (EV1) distribution, which has the following form:

$$P(\varepsilon_j \leq \varepsilon) = \exp(-\exp -\varepsilon)$$

Equipped with the IID and EV1 assumptions, we proceed to complete the model. Louviere et al. (2000, Chapter 3) took on the full derivation of the MNL model, and ended with the following:

$$P_i = \frac{\exp V_i}{\sum_{j=1}^{J} \exp V_j} \; ; \quad j = 1, \dots, i, \dots, J \quad i \neq j$$

In words, this states that the probability of an individual choosing alternative i out of J alternatives is equal to the ratio of the exponential of the observed utility index for alternative i to the sum of the exponentials of the observed utility indices for all J alternatives including the ith alternative.

5.2 Estimating the Model

Our model can be estimated using maximum likelihood techniques. Letting I_{nj} be a dummy variable that takes value 1 if individual n chooses the alternative j and 0 otherwise, the log-likelihood function of the model for a total number of respondents N is given by:

$$\ln L = \sum_{n=1}^{N} \sum_{j=1}^{J} I_{nj} \ln P_{nj}$$

The parameters to be estimated are the weights β of the attributes in the utility function, and these can be estimated by maximizing the log-likelihood function above (it should be noted that the weights β reside inside the term P_{nj}). Once β are estimated, we can calculate the WTP figures. Since X consists of $K = 7$ attributes and one of the attributes is the price attribute p, the marginal willingness to pay (MWTP) for a change in the level of one attribute k and the willingness to pay (WTP) for the whole service in question resulting from changes in the levels of all the attributes can be calculated as shown by Lancsar and Savage (2004):

$$MWTP_k = \frac{\frac{dV}{dX_k}}{-\frac{dV}{dp}} = \frac{\beta_k}{-\beta_p}$$

$$WTP = \sum_{k=1}^{K} \frac{\beta_k}{\beta_p} (\Delta X_k)$$

5.3 Results

5.3.1 The Goodness of Fit of the Model

The MNL model is estimated using NLOGIT v5.0 software package. In order to determine the goodness of fit of the estimated model, we compare it to the constants-only model using the likelihood-ratio (LL-ratio) test. LL for our model was computed as −1,154.13, and LL for the constants-only model as −1,340.89. The LL-ratio test is given as follows:

$$-2 * (LL\ constants\ only\ model - LL\ estimated\ model) \sim chi\ square$$

For our model,

$$-2LL = -2\big(-1340.89 - (-1154.13)\big) = 373.52$$

The critical value of chi square at 95% significance level with d.f. 7 (degrees of freedom for the test is the difference in the number of estimated parameters in the two models = 8 – 1 = 7) is 14.07. The LL-ratio test result, 373.52, is larger than this chi-critical, so we reject the null hypothesis that the estimated model is not better than the constants-only model.

5.3.2 Results of MNL Estimation

The results of the model estimation are presented in Table 5.1.

Table 5.1: Results of MNL Model Estimation

Variables	β-coefficient	Standard Error	95% Confidence Interval	
ASC	−.59350***	.16673	−.92029	−.26671
FAST	.63411***	.11140	.41578	.85245
VERYFAST	.71585***	.12728	.46638	.96531
UNLIMITED	.25375***	.08938	.07857	.42893
QUALITY	−.15118*	.08865	−.32494	.02257
TURKEY	.92894***	.09394	.74482	1.11307
SOUTHCYPRUS	.61745***	.09041	.44025	.79465
PRICE	−.03141***	.00234	−.03599	−.02683

Note: ***, **, * indicate statistical significance at the 1%, 5%, 10% levels, respectively.

All the estimated coefficients for the attributes in the utility function are significant at the 1% level, except the coefficient for the quality attribute. The coefficient of quality is statistically insignificant at the 1% and 5% levels, and its 95% confidence interval contains zero. We conclude that the study finds no evidence that an improved quality of mobile services will enhance consumers' utility.

The signs of the estimated coefficients are consistent with our expectations (again, except for the quality attribute, which we already accepted to be statistically insignificant). Attributes for fast speed, very fast speed, unlimited internet, unrestrained use in Turkey and unrestrained use in South Cyprus all have a positive impact on consumers' utility, whereas price has a negative impact. The estimated coefficient for unrestrained use in Turkey is the greatest, which implies that this is the attribute that improves consumers' utility the most. Coefficients for very fast speed, fast speed, unrestrained use in South Cyprus, and unlimited internet use follow, respectively.

We can calculate the MWTP for each attribute from the estimated coefficients, using the formula given in section 5.2. Table 5.2 shows the MWTP figures and their 95% confidence intervals. The confidence intervals are computed using EC Fieller's method (Motulsky, 1995).

Table 5.2: MWTP for the Attributes

Attributes	MWTP (TL/month)	95% Confidence Interval (TL/month)	
Fast mobile internet speed (30 Mbps)	20.19	12.98	28.28
Very fast mobile internet speed (300 Mbps)	22.79	14.56	32.01
Unlimited mobile internet use	8.08	2.49	14.02
Improved quality (speaking and internet)	−4.81	−10.56	0.72
Unrestrained use in Turkey	29.57	22.83	37.61
Unrestrained use in South Cyprus	19.66	13.67	26.50

The attribute with the greatest MWTP is unrestrained use in Turkey. Consumers, on average, are willing to pay an extra 29.57 TL (11.73 USD) per month for their MC service if they receive unrestrained use in Turkey. The amount they are willing to pay for very fast internet speed at 300 Mbps is 22.79 TL (9.04 USD) per month, whereas it is 20.19 TL (8.01 USD) per month for a more modest internet speed of 30 Mbps. The MWTP figures for unrestrained use in South Cyprus and for unlimited internet use are 19.66 TL (7.80 USD) and 8.08 TL (3.21 USD) per month, respectively. The MWTP for improved quality is a negative value; however, its 95% confidence interval contains zero, and we can assert that estimated MWTP for improved quality is not different from zero at the 5% level of significance.

These results indicate strong consumer preference for mobile services to be available in Turkey and in South Cyprus with no restrictions. The survey respondents are paying an average of 107.23 TL/month (see Chapter 4, Table 4.2) for their current service, and are willing to accept a 28% increase in their monthly mobile bill for unrestrained roaming in Turkey and an 18% increase for the same in South Cyprus. One reason that roaming in Turkey is valued higher than that in South Cyprus could be that citizens of North Cyprus travel to South Cyprus by car mostly for day trips, whereas they take a flight to visit Turkey and stay longer. It could be argued that consumers can handle missing out on mobile services for short periods, but not for longer trips. Therefore, an individual who travels to both destinations may value free roaming more in Turkey than in South Cyprus. An additional factor is that the number of survey respondents regularly traveling to Turkey is larger than the number regularly traveling to South Cyprus. 230, out of the 320 surveyed, report that Turkey is a regular destination, whereas 185 report the same for South Cyprus (see Chapter 4, Table 4.2). Since more people need mobile services in Turkey, the average MWTP for Turkish roaming rises. It should be further noted from the survey statistics in Table 4.2, that 276 respondents, or 86% of the surveyed, travel to either or both of the two destinations, which explains why people are interested in unrestrained roaming so much.

The results of the study also suggest that there is substantial demand for the upgrade of mobile services in North Cyprus to the 4G grade, with unlimited use if possible. Consumers are willing to pay 19% to 21% more than they currently pay in order to have faster 4G-rate connection speeds, and 8% more in order to receive unlimited mobile internet use. These results are in line with the survey statistics (Table 4.2), which show that consumers are already using data-intensive mobile applications such as social networking (89%), instant messaging (66%) and watching videos (41%). Faster data rates will enhance consumers' mobile experience.

Chapter 6

CVM RESULTS

6.1 Introduction

The second section of the survey is devoted to the Contingent Valuation Method (CVM) study. As described in detail in Chapter 2, CVM asks the respondents to state their willingness to pay directly, as opposed to having them make choices and inferring their WTP from these choices.

The section starts with a description of the Fourth Generation (4G) mobile technology. This is intended so that the respondents are as informed as possible, while stating their WTP for 4G. According to this description, 4G enables both high-quality voice conversation and very high speed mobile internet connectivity, easily in the range of 30 Mbps, whereas 3G offers a data rate of about 3 Mbps. The benefits of 4G are listed as follows:

- Mobile "videophone" conversations can be made.
- Videos and movies on the internet will display instantly.
- Real-time games on the internet can be played while mobile.
- No freezing/disconnection in the video/movie/game stream while on the move. (e.g. travelling in a car)
- Very large file transfers can be made instantly over the internet.

- Cloud computing can be used while mobile. With the very high speed mobile internet connectivity, all personal files can be stored on the internet and displayed on all personal mobile devices.
- Because 4G mobile internet service can be used for home internet connection as well, you may opt not to purchase a separate home internet service.

The descriptive introduction also states that another advantage of the 4G technology when compared with 3G, is that 4G is better in quality. In other words 4G provides a higher quality voice conversation and mobile internet connection capability, as 4G users never experience any freezing or disconnection while speaking on their mobile phone or surfing the internet.

Then, the respondents are asked to state their WTP, as an additional cost on their current mobile expenditure, for a "4G service which provides mobile internet speed 10 times faster than 3G, unlimited internet use, and no freezing/disconnection in speaking or internet connectivity". The CVM question is asked in the 'payment ladder' format. In this format, the respondents are presented with a ladder of prices, and they are required to tick the highest amount they would pay for 4G, and to cross the first (lowest) amount they would not pay. The tick stands for the minimum WTP, and the cross stands for the maximum WTP. Therefore, we obtain an interval where the respondent's true WTP lies. It should be noted that the payment ladder approach is preferable to an open-ended question because the open-ended elicitation technique is prone to non-responses and to strategic bias as mentioned in Section 4.2.

6.2 Data

All 320 respondents of the survey answered the CVM section. Of these 320, 26 stated that they would not go for 4G (i.e., their WTP is nil). These respondents were further required to state the reason(s) why they would not go for 4G. Table 6.1 presents the list and the frequency of the reasons given.

Table 6.1: Reasons for Zero WTP

#	Reason	Frequency
1	3G is good enough/do not need 4G	12
2	Do not need to use mobile internet	6
3	Do not know how to use internet	3
4	4G should be introduced without extra cost	2
5	3G is bad, 4G is even worse (?)	1
6	Prefers to use WiFi instead of 3G/4G	1
7	No specific reason	1
	Total	**26**

Reason #4 is considered to be a protest response, since it does not necessarily imply that the respondent puts zero value on a 4G service. Therefore we remove these 2 protest responses from the CVM study, so as to avoid a bias due to invalid zero bids. We are left with 318 observations, 24 of which are true zero WTP bids, and the remaining 194 are non-zero bids. Table 6.2 shows the frequencies for the ticks and for the crosses provided by the survey takers.

Table 6.2: Frequencies of Ticks and Crosses

Bid (TL)	**Ticks (lower bound of WTP)**	**Crosses (higher bound of WTP)**
0	24	24
5	47	0
10	66	14
15	50	25
20	56	36
25	37	47
30	18	42
40	9	46

50	8	45
70	2	28
100	0	9
150	1	0
200	0	2
300	0	0
Total	**318**	**318**

6.3 Turnbull Lower Bound Mean for WTP

If we use a parametric approach to estimate the WTP using the CVM data, we need to make a distributional assumption. The estimated result is not robust against distributional misspecification. Therefore, we opt to take a non-parametric approach to estimating the mean WTP for 4G.

The first non-parametric estimate we take on is the Turnbull Lower Bound Mean (LBM), suggested by Turnbull (1976). Turnbull LBM is known to be a conservative WTP estimate, because it utilises only the lower bound information (the 'ticks') from the CVM survey. As the first step, we take the tick data from Table 6.2, remove the zero frequency bids, and calculate the cumulative number and proportion of ticks for each bid. This is given in Table 6.3. The empirical survivor function is graphed in Figure 6.1.

Table 6.3: Cumulative Number and Proportion of Ticks

i	**Bid (B_i)**	**Number of ticks**	**Cumulative number of ticks**	**Cumulative proportion of ticks (p_i)**
1	0	24	318	100,00%
2	5	47	294	92,45%
3	10	66	247	77,67%
4	15	50	181	56,92%
5	20	56	131	41,19%
6	25	37	75	23,58%
7	30	18	38	11,95%

8	40	9	20	6,29%
9	50	8	11	3,46%
10	70	2	3	0,94%
11	150	1	1	0,31%
12	200	0	0	0,00%

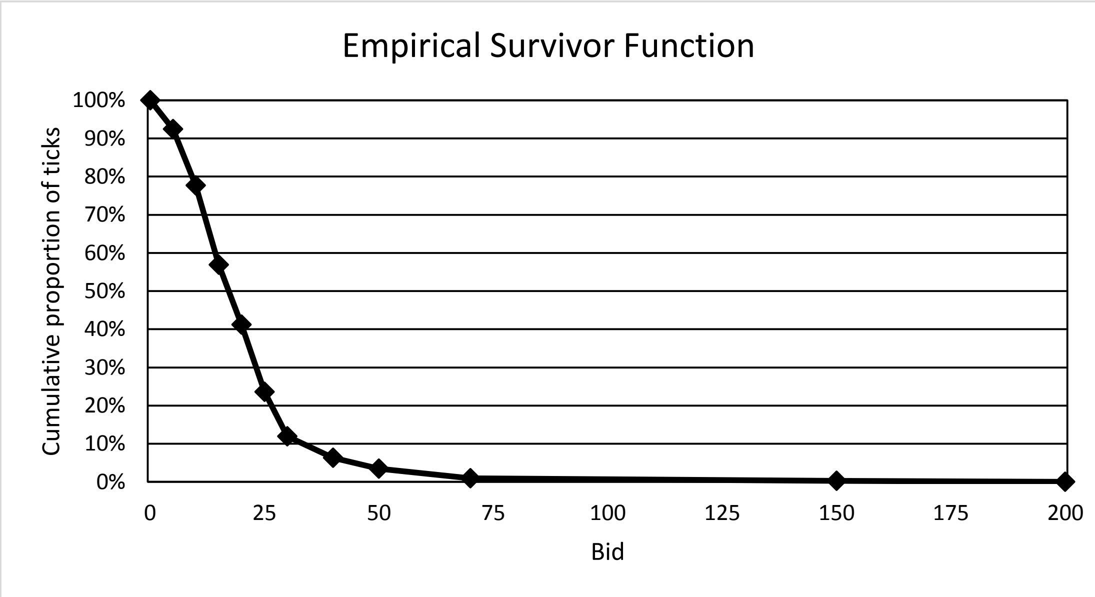

Figure 6.1: The Empirical Survivor Function

The steps to calculate the Turnbull LBM mean is given by Haab and McConnell (1997). The formula for the mean is given as:

$$LBM(Turnbull) = p_1 B_1 + \sum_{i=2}^{m} p_i (B_i - B_{i-1})$$

where m is the total number of bids. The formula for the variance of the LBM is given as:

$$Var(LBM) = \sum_{i=1}^{m} \frac{p_i (1 - p_i)(B_i - B_{i-1})^2}{N}$$

where N is the total number of observations (which is 318 in our study).

Table 6.4 shows the calculation of Lower Bound Mean, and the variance of LBM.

Table 6.4: Calculating LBM and Var(LBM)

i	Bid (B_i)	Number of ticks	Cumulative number of ticks	Cumulative proportion of ticks (p_i)	LBM $p_i*(B_i-B_{i-1})$	Var (LBM) $[p_i*(1-p_i)*(B_i-B_{i-1})^2]/N$
1	0	24	318	100,00%	0,00	0,000
2	5	47	294	92,45%	4,62	0,005
3	10	66	247	77,67%	3,88	0,014
4	15	50	181	56,92%	2,85	0,019
5	20	56	131	41,19%	2,06	0,019
6	25	37	75	23,58%	1,18	0,014
7	30	18	38	11,95%	0,60	0,008
8	40	9	20	6,29%	0,63	0,019
9	50	8	11	3,46%	0,35	0,011
10	70	2	3	0,94%	0,19	0,012
11	150	1	1	0,31%	0,25	0,063
12	200	0	0	0,00%	0,00	0,000
				Total:	**16,60**	**0,18**

We calculate LBM = 16.60 TL, and Var(LBM) = 0.18.

6.4 Kriström Mean

Kriström (1990) proposes another non-parametric approach to estimate mean WTP in a CVM study. This approach produces a higher estimate than the Turnbull approach. Kriström (1990) argues that this method is simple to execute and it will not produce inconsistent results due to any misspecified distribution.

The Kriström mean is estimated by approximating the area under the survivor function in Figure 6.1. We assume the survivor function is linear within each bid interval, so we approximate the area underneath as the sum of trapezoids:

Kriström mean = (5-0)*(92.45%+100%)/2 + (10-5)*(77.67%+92.35%)/2 + ... + (200-150)*(0%+0.31%)/2 = 19.81 TL

6.5 Upper Bound Mean

Vaughan and Rodriguez (2001) demonstrate a procedure to calculate an Upper Bound Mean for WTP, similar to the procedure for calculating the Turnbull Lower Bound Mean:

$$UBM = \sum_{i=1}^{m} p_i(B_{i+1} - B_i)$$

Taking on the calculation:

UBM = (5-0)*100% + (10-5)*92.45% + ... + (200-150)*0.31% = 23.02 TL

Therefore, the estimated non-parametric means for the WTP of a 30 Mbps 4G service can be ordered as follows:

Turnbull Lower Bound Mean (16.60 TL) < Kriström mean (19.81 TL) < Upper Bound Mean (23.02 TL)

6.6 Sensitivity Analysis

Having calculated the WTP means estimated by the CVM methodology, we turn to analysing the sensitivity of the WTP to mobile use frequency and demographic characteristics of the respondents.

For this purpose, we estimate an empirical model for the maximum WTP for 4G, which depends in turn on the following explanatory variables: mobile use frequency (hours per week), age, gender, education (years of schooling) and income (net monthly income in Turkish Liras). We use the lower bound information (the ‘ticks’ from the CVM question) for the WTP data, and the answers to the survey questions for the explanatory variables data. We run an Ordinary Least Squares (OLS) regression in SPSS software package version 20. Table 6.5 depicts the estimation results from the sensitivity analysis.

Table 6.5: Sensitivity Analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	p-value
	B	Std. Error	Beta		
(Constant)	-7,015	5,875		-1,194	0,234
mobileuse	,123***	0,043	0,178	2,882	0,004
age	,505***	0,108	0,324	4,685	0,000
gender	1,386	1,773	0,049	0,782	0,435
education	,756**	0,35	0,144	2,162	0,032
income	-,002***	0,001	-0,223	-3,099	0,002
R	0,345				
R Square	0,119				
Adjusted R Square	0,101				
Std. Error of the Estimate	13,539				
F	6,414				
p-value	0,000				

Asterisks *, ** and *** denote significance at the 10 percent, 5 percent and 1 percent level, respectively.

The regression output displays an R-Squared value of 0,119 and an Adjusted R-Squared value of 0,101. This means only about 10% of the variation in WTP figures can be explained by the explanatory variables that we picked. However, this does not mean that our analysis is not useful, as our main aim is to find if there is any statistically significant relationship between demographic characteristics and willingness to pay for 4G.

The estimation results indicate that mobile use, age, education and income are significantly related with people's WTP for 4G, whereas we find that gender has no role to play (with a p-value of 0,435). The higher the mobile use frequency, the age, and the years of schooling the more money people are willing to pay for 4G. Surprisingly, we find a negative relation between monthly income and WTP. People are willing to pay 0,123TL more for 4G for every hour of mobile use per week, or 0,505TL more for every year they are older, or 0,756TL more for every year spent in schooling. People are willing to pay 0,002TL less, for every TL more in monthly earnings. These results suggest that a hypothetical respondent whose mobile use and demographic characteristics are at the means of those of the respondents used in the OLS regression (i.e., 25,72 hours of mobile use per week, 32,47 years of age, 12,29 years of education, and 2571,54 TL of monthly income) would display a willingness to pay for 4G of 16,69 TL per month. This is in fact very close to the Turnbull Lower Bound Mean WTP for 4G, estimated to be 16,60 TL per month in Section 6.3.

We suspect the surprising sign of the coefficient on income occurs due to missing values in the data. 51 respondents of the survey refused to report their monthly income. SPSS handles the missing values in the data by the 'listwise deletion' method which means it completely omits the cases with the missing values in its analysis. It is highly probable that the missing values in income are not random; we believe that it is mostly those people with higher incomes who did not answer the income question. This produces bias in the estimated coefficient of the income variable in the regression analysis. Therefore the outcome that there is a negative relation between WTP for 4G and income is not reliable.

We conclude from the sensitivity analysis that the willingness to pay for 4G is positively related with mobile use frequency, age and education. This finding should be of interest to telecommunications policy makers, and to GSM operators analysing 4G investment possibilities.

6.7 Revenue and Consumer Surplus

We further investigate the contingent valuation data by aggregating the respondents' WTP responses to form a demand curve of 4G services for the whole market, and to develop an estimate of the consumer surplus, which is measured by the area under the demand curve but above the price charged. Demand curve formed using the sample data is given in Figure 6.2.

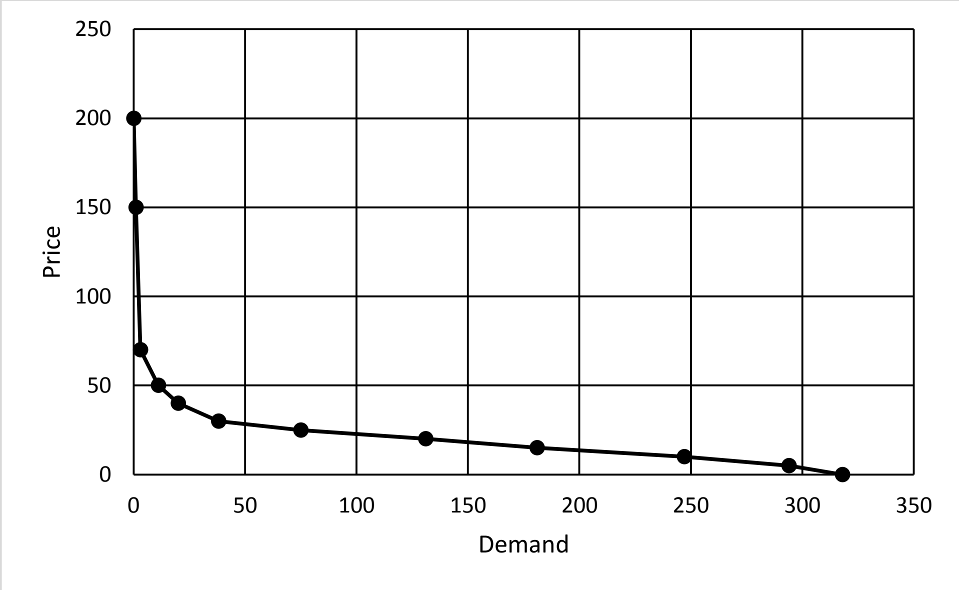

Figure 6.2: Demand Curve for 4G

We apply this curve to the total number of mobile subscribers in the market, by assuming the same structure of WTP frequencies as the sample. According to Yeniduzen (2015), as of July 2015, there are more than 500.000 active subscribers of mobile services in the North Cyprus market. We use this information to calculate the aggregate monthly revenue and consumer surplus figures under alternative pricing strategies, as shown in Table 6.6.

Table 6.6: Aggregate Monthly Revenue and Consumer Surplus with Alternative Prices

Price willing to pay (TL/month)	**Number of respondents**	**Cumulative number of respondents**	**Cumulative percentage of respondents**	**Number of active mobile subscribers**	**Total revenue (TL/month)**	**Consumer Surplus (TL/month)**	**Price Elasticity**
0	24	318	100,00%	500.000	0	9.903.125	NA

5	47	294	92,45%	462.250	2.311.250	7.497.500	0,04
10	66	247	77,67%	388.350	3.883.500	5.371.000	0,26
15	50	181	56,92%	284.600	4.269.000	3.688.625	0,77
20	56	131	41,19%	205.950	4.119.000	2.462.250	1,12
25	37	75	23,58%	117.900	2.947.500	1.652.625	2,45
30	18	38	11,95%	59.750	1.792.500	1.208.500	3,60
40	9	20	6,29%	31.450	1.258.000	752.500	2,17
50	8	11	3,46%	17.300	865.000	508.750	2,61
70	2	3	0,94%	4.700	329.000	288.750	3,44
150	1	1	0,31%	1.550	232.500	38.750	1,39
200	0	0	0,00%	0	0	0	7,00
300	0	0	0,00%	0	0	0	NA

As observed from Table 6.6, a consumer surplus of almost 10M TL will accrue every month, if 4G is introduced without additional fees. As the price is increased, the 4G providers will start to earn revenues, but the aggregate consumer surplus will fall. The higher the price, the participation of mobile subscribers in 4G will drop. For instance, if 4G is priced at 10TL per month, 77,67% of mobile subscribers will participate, but if the price is raised to 40TL per month, only 6,29% will participate. Reynisdottir et al. (2008) suggest that a good way to price a new service is to look at the price elasticity. If the price is picked from the inelastic part of the demand curve, this will prevent a higher than proportional decrease in participation numbers. Therefore, the total revenue will increase, without hurting participation too much. As shown in Table 6.6, demand for 4G is inelastic up to the price of 20TL per month. A price of 15 TL per month, for instance, will both maximise monthly revenues at 4,27M TL, and also keep more than half of mobile users benefiting from 4G.

Estimating the revenues and the resulting consumer surplus is essential in designing tenders and licensing auctions. Policy makers can combine this knowledge with additional information about the cost requirements of the investment to maximise the value of the tender/auction for the government. Without an informed auction design on the government's side, the GSM operators will easily get all of the surplus for themselves.

Chapter 7

CONCLUSION

7.1 Discussion and Conclusion

The aim of this dissertation is to explore the current issues in the North Cyprus mobile services market, and to find out the most valuable service improvements for the people. We select the attributes of interest through a careful process of preliminary research. MNP is one important improvement that people demand, but without any additional cost, as they believe MNP is a consumer right. Therefore, we exclude MNP from our final list of attributes.

The current mobile technology available in North Cyprus is 3G. It is rumoured that the government will be auctioning 4G licences in the near future. Although 4G is already launched in many countries, there are many regions and countries which are not yet covered. In fact, most areas which do have 4G coverage have to settle for only a fraction of the top speeds offered by the most advanced technology. According to a report by OpenSignal in March 2015 (Westwood, 2015), the USA ranks 26th in the world for 4G data rates, with an average rate of 7 Mbps, much less than the 300 Mbps achieved by 4G LTE-A CA technology. There is room for growth for the 4G market all over the world, and there is need for more empirical research on the sector in order to determine whether new investments on technology are viable. This study is the first attempt in the MC literature to evaluate consumer preferences for several levels of mobile data rates, including the top rate possible as of today.

Another potential value of mobile telecommunications is that it could replace fixed broadband connection to homes, especially in remote areas where there is no existing fixed infrastructure. It would be very costly to lay new fibre or cable infrastructure to sparsely populated regions, and wireless connection via mobile operators could be a solution. The EU's Digital Agenda requires that the entire EU be covered by broadband above 30 Mbps by 2020 (EC, 2015). 4G could prove to be the most economical way to achieve this aim in areas currently lagging behind, such as North Cyprus. However, 4G needs to be offered to the consumer with no data caps if it is to compete with fixed broadband technologies. This study also addresses the question of whether removing the data caps has any value for consumers.

Finally, it is a common problem for people who are travelling to have to pay excessive roaming fees for their mobile services while abroad. The high cost in a roaming transaction arises because the foreign operator providing the roaming service charges the home operator with profit-maximising incentives, and this gets passed down to the user usually with some added retail mark-up from the home operator. Inter-operator roaming tariffs are negotiated between operators individually, but at an uneven table. The initially technical and lately commercial obstacles to switching roaming traffic between networks, and the need for multiple contracts with several operators in every country (for continued coverage) have limited competition between the suppliers of roaming services (Salsas and Koboldt, 2004). Benefits obtained through trans-national mergers, acquisitions and operator alliances have not been passed on to the consumers. Suppliers seek profit maximisation, and the roaming tariffs remain high (Sutherland, 2012). This problem could be solved through bilateral action between governments aimed at regulating roaming fees for visitors in their countries. By this way, both governments partaking in the bilateral agreement can dictate price caps on their domestic operators for the roaming traffic provided to the partnering country. The EU, for one, has put great effort into regulating roaming between EU member states. Infante and Vallejo (2012) reported that "intra-EU voice and SMS roaming prices have suffered a steep decline from 2007 to 2010, following the glidepath set by regulation". Unfortunately, roaming regulation is very low down on government agendas elsewhere, and this study is the first to quantify how valuable free roaming policy could be for the population in a developing country.

The most obvious policy implication of the study presented in this dissertation is that the government of North Cyprus can produce great value for the population simply by making bilateral roaming deals with the governments of neighbouring countries. We find that unrestrained use in Turkey is the most valued item in our attributes list (29.57 TL per month). In addition, using the formula in Chapter 5, Section 5.2 for the addition of MWTPs, we find that the elimination of roaming fees in both Turkey and South Cyprus is worth a total of 49.23 TL per month for consumers. This is more than twice the value of introducing 4G, which we find to be worth around 20 TL per month. In fact, it is about 2% of the average monthly income of the survey respondents (reported as 2,504.41 TL per month in Table 4.2). These are remarkable findings which policy-makers cannot overlook.

Although we find the benefits of roaming regulation to be noteworthy, potential drawbacks should also be considered. Opponents of the policy claim that it will lead to the so-called "waterbed effect": forcing roaming mobile prices down will cause domestic mobile prices to go up. Sutherland (2012) analyses the regulatory measures undertaken by the European Union for intra-EU roaming, and observes that the waterbed effects have been in foreign rather than domestic prices. Operators have sought to recover their lost revenues by raising their wholesale prices for non-European operators, and retail prices for European customers travelling beyond Europe. However, it should be noted that there is no economic force pushing the prices up; operators are simply switching their focus to other markets where they have limited competition and no regulation, in order to maximise their profits. Therefore, Sutherland (2012) recommends that any proposal for roaming regulation should be thoroughly evaluated and coordinated as widely as possible. For instance, in the case of North Cyprus, the government may consider to sign a roaming agreement with Turkey and South Cyprus, only if it includes the wider EU region, since a fair number of North Cypriots travel to various European destinations as well.

Coming back to the results of our study, we find 4G is also very valuable for consumers in North Cyprus. This is a message to the government of North Cyprus, and to the administrations of all regions not covered by 4G, that they need to accelerate the pace of introduction of 4G. Two other very useful findings concerning 4G relate to the quality and the data rates to be provided with 4G. First, we find that consumers are happy with the quality they experience with 3G, and are not willing to pay anything extra for improved quality. We conclude that 4G investments in North Cyprus may opt not to focus on quality improvements. Second, we find that consumers' MWTPs for a 30 Mbps 4G experience (20.19 TL per month) and for a 300 Mbps 4G experience (22.79 TL per month) do not differ greatly. In fact, we calculate the 80% confidence limits for the difference of these MWTPs to be −4.30 and 9.51, using EC Fieller's method (Motulsky, 1995). This interval contains the zero point, so we cannot reject at the 20% level the null hypothesis that people are indifferent between 30 Mbps 4G and

300 Mbps 4G. Restating this from another perspective, we can reject the null hypothesis that 300 Mbps 4G is worth at least 10 TL more than 30 Mbps 4G, with 90% confidence. Either way, the conclusion is that mobile operators in North Cyprus (and, possibly, in most countries in the world) need not build the most advanced (and costly) 4G technology that provides the top data rates that are technically possible, at least not for the time being.

Consumers' nonlinear valuation of mobile data rates deserves some attention. A similar result was noted by Rosston et al. (2010), where the authors report a very small difference between the MWTPs for a fast broadband service and for a very fast broadband service. There are two possible explanations for these findings. On one hand, the consumers may be fully aware of what they can do with the top data rates, but do not find any considerable value in it. Most data-intensive applications such as HD video streaming and online gaming run seamlessly at 300 Mbps, but they can also be used at 30 Mbps with only a few hiccups. Although tech enthusiasts will always aspire to better and faster technology, regular people might simply find the super-fast rates unnecessary. On the other hand, it is possible that the consumers are lacking the experience needed to make an accurate valuation of the technology. After all, our survey respondents have experience only with the slow 3G rates, and although the survey carefully informs them about the benefits of faster rates, it may be difficult to appreciate the difference between a 30 Mbps service and a 300 Mbps service without actually using both. Consumers may have a higher opinion of the technology, once they are familiar with it. It should be further noted that, as in the case of most technological improvements, the market may evolve in time to introduce more uses for the super-fast data rates, enhancing the value for consumers in due course.

The arguments above also hold for the broader valuation of the 4G technology. The realized welfare impact may exceed the figures calculated in this study after the launch of 4G in North Cyprus. Since the consumers will be more aware of the capabilities of the technology, they could place a higher value on 4G when asked about the compensation they would require to give up 4G. This is in fact the difference between WTP and WTA (willingness to accept) evaluations, and theorists have long debated which of these represents the true valuation of a commodity or a service (Hanemann, 1991). Practitioners like Mitchell and Carson (1989) or the members of the NOAA panel (1993) recommend to use WTP for practical purposes, since WTP is the conservative choice and should be preferred in a cost-benefit study to be on the safe side. While the recommendation justifies our use of WTP methodology, we acknowledge that we find a lower limit for the value of 4G in North Cyprus.

We conclude by noting that bilateral roaming regulation could also prove to be more valuable for the overall economy, than the figures we estimate. This is because, in this study, we focused on the local consumers of mobile services in North Cyprus, but the policy may have an additional benefit for the country. North Cyprus is a small island economy which thrives on tourism. When the government of North Cyprus makes a deal with its counterpart in Turkey, for instance, to take action on excessive roaming fees in both territories, this will benefit not only North Cypriot citizens travelling to Turkey, but also Turkish tourists visiting North Cyprus. This, in turn, will enhance the tourist package that North Cyprus is offering to the Turkish market and attract more tourists to North Cyprus from Turkey. The roaming regulation will create considerable value for the tourism sector in North Cyprus, in addition to the value created for the local consumers of mobile services. Quantifying the impact on tourism is the subject of another study, but this is one more argument in favour of free roaming policy.

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APPENDICES

Appendix A: Experiment Design Tables

A.1 Two-way Interactions

Profiles	A	B	C	D	E	F	G	AB	AC	AD	AE	AF	AG	BC	BD	BE	BF	BG	CD	CE	CF	CG	DE	DF	DG	EF	EG	FG
1	0	0	1	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	0	0	0	0	5	0
2	2	1	0	1	0	2	5	2	0	2	0	4	10	0	1	0	2	5	0	0	0	0	0	2	5	0	0	10
3	1	0	0	1	0	3	4	0	0	1	0	3	4	0	0	0	0	0	0	0	0	0	0	3	4	0	0	12
4	0	0	1	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	0	0	0	8
5	1	0	0	1	1	1	5	0	0	1	1	1	5	0	0	0	0	0	0	0	0	0	1	1	5	1	5	5
6	0	0	0	1	1	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	6	0	6	0
7	1	0	1	1	1	3	1	0	1	1	1	3	1	0	0	0	0	0	1	1	3	1	1	3	1	3	1	3
8	2	0	0	0	0	1	3	0	0	0	0	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
9	0	0	1	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	3	0	0	0
10	0	1	1	1	1	3	3	0	0	0	0	0	0	1	1	1	3	3	1	1	3	3	1	3	3	3	3	9
11	2	0	0	0	1	3	2	0	0	0	2	6	4	0	0	0	0	0	0	0	0	0	0	0	0	3	2	6
12	0	1	1	1	0	1	2	0	0	0	0	0	0	1	1	0	1	2	1	0	1	2	0	1	2	0	0	2
13	2	1	1	1	0	0	1	2	2	2	0	0	2	1	1	0	0	1	1	0	0	1	0	0	1	0	0	0
14	0	0	1	1	1	2	2	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2	1	2	2	2	2	4
15	0	1	0	1	0	3	6	0	0	0	0	0	0	0	1	0	3	6	0	0	0	0	0	3	6	0	0	18
16	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2
17	0	1	1	0	1	1	4	0	0	0	0	0	0	1	0	1	1	4	0	1	1	4	0	0	0	1	4	4
18	1	1	0	0	1	2	3	1	0	0	1	2	3	0	0	1	2	3	0	0	0	0	0	0	0	2	3	6
19	2	1	0	1	1	0	4	2	0	2	2	0	8	0	1	1	0	4	0	0	0	0	1	0	4	0	4	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	1	1	0	0	0	0	2	1	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
22	1	0	1	1	0	1	0	0	1	1	0	1	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0
23	1	1	1	0	0	2	6	1	1	0	0	2	6	1	0	0	2	6	0	0	2	6	0	0	0	0	0	12
24	0	1	1	0	0	3	5	0	0	0	0	0	0	1	0	0	3	5	0	0	3	5	0	0	0	0	0	15

25	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1
26	0	1	0	1	1	1	7	0	0	0	0	0	0	0	1	1	1	7	0	0	0	0	1	1	7	1	7	7
27	2	0	1	0	0	3	7	0	2	0	0	6	14	0	0	0	0	0	0	0	3	7	0	0	0	0	0	21
28	2	1	1	1	1	2	0	2	2	2	2	4	0	1	1	1	2	0	1	1	2	0	1	2	0	2	0	0
29	2	0	1	0	1	1	6	0	2	0	2	2	12	0	0	0	0	0	0	1	1	6	0	0	0	1	6	6
30	1	1	1	0	1	0	7	1	1	0	1	0	7	1	0	1	0	7	0	1	0	7	0	0	0	0	7	0
31	0	0	0	1	0	2	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7	0	0	14
32	0	1	0	0	1	3	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	3	0	0

A.2 Correlation Matrix

	A	B	C	D	E	F	G	AB	AC	AD	AE	AF	AG	BC	BD	BE	BF	BG	CD	CE	CF	CG	DE	DF	DG	EF	EG	FG
A	1																											
B	0	1																										
C	0	0	1																									
D	0	0	0	1																								
E	0	0	0	0	1																							
F	0	0	0	0	0	1																						
G	0	0	0	0	0	0	1																					
AB	0,6	0,5	0	0,2	0	-0,2	-0,1	1																				
AC	0,6	0	0,5	0	0	0	0	0,4	1																			
AD	0,6	0,2	0	0,5	0	-0,1	-0,2	0,7	0,4	1																		
AE	0,6	0	0	0	0,5	0	0,0	0,4	0,4	0,4	1																	
AF	0,7	-0,2	0	-0,1	0	0,5	0,0	0,2	0,4	0,3	0,4	1																
AG	0,7	-0,1	0	-0,2	0,0	0,0	0,4	0,3	0,4	0,2	0,4	0,6	1															

BC	0	0,6	0,6	0	0	0	0	0,3	0,3	0,1	0	-0,1	-0,1	1														
BD	0,2	0,6	0	0,6	0	0	0	0,5	0,1	0,5	0,1	0,0	0,0	0,3	1													
BE	0	0,6	0	0	0,6	0	0	0,3	0	0,1	0,3	-0,1	-0,1	0,3	0,3	1												
BF	-0,2	0,7	0	0	0	0,5	0	0,1	-0,1	0,0	-0,1	0,0	-0,2	0,4	0,4	0,4	1											
BG	-0,1	0,7	0	0	0	0	0,5	0,3	-0,1	0,0	-0,1	-0,2	0,1	0,4	0,4	0,4	0,5	1										
CD	0	0	0,6	0,6	0	0	-0,5	0,1	0,3	0,3	0	0,0	-0,3	0,3	0,3	0	0	-0,2	1									
CE	0	0	0,6	0	0,6	0	0	0	0,3	0	0,3	0	0,0	0,3	0	0,3	0	0	0,3	1								
CF	0	0	0,7	0	0	0,5	0	-0,1	0,4	0,0	0	0,2	0,0	0,4	0	0	0,3	0	0,4	0,4	1							
CG	0	0	0,7	-0,4	0	0	0,5	-0,1	0,4	-0,3	0,0	0,0	0,4	0,4	-0,2	0	0	0,2	-0,1	0,4	0,5	1						
DE	0	0	0	0,6	0,6	0	0	0,1	0	0,3	0,3	0,0	-0,1	0	0,3	0,3	0	0	0,3	0,3	0,3	-0,2	1					
DF	-0,1	0	0	0,7	0	0,5	0	0,0	0,0	0,3	0,0	0,1	-0,2	0	0,4	0	0,3	0,0	0,4	0,3	0,3	-0,3	0,4	1				
DG	-0,2	0	-0,4	0,7	0	0	0,5	0,0	-0,3	0,2	-0,1	-0,2	-0,1	-0,2	0,4	0	0,0	0,2	-0,1	-0,2	-0,3	-0,4	0,4	0,5	1			
EF	0	0	0	0	0,7	0,5	-0,4	-0,1	0	0,0	0,4	0,2	-0,2	0	0	0,4	0,3	-0,2	0,3	0,4	0,3	-0,2	0,4	0,3	-0,2	1		
EG	0,0	0	0	0	0,7	-0,4	0,5	-0,1	0,0	-0,1	0,4	-0,2	0,2	0	0	0,4	-0,2	0,3	-0,2	0,4	-0,2	0,2	0,4	-0,2	0,2	0,1	1	
FG	0,0	0	0	0	-0,3	0,7	0,6	-0,2	0,0	-0,2	-0,2	0,4	0,3	0	0,0	-0,2	0,3	0,3	-0,3	-0,2	0,4	0,3	-0,2	0,3	0,3	-0,1	-0,2	1

A.3 Profiles for Service B – 6 possible scenarios

		Service A						Service B						
Profiles	G	A	B	C	D	E	F	A	B	C	D	E	F	Code-sum difference
Scenario 1	Blocking	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	
20	0	0	0	0	0	0	0	1	1	1	1	1	1	3,5
22	0	1	0	1	1	0	1	2	1	0	0	1	2	0,5
28	0	2	1	1	1	1	2	0	0	0	0	0	3	7,5
32	0	0	1	0	0	1	3	1	0	1	1	0	0	5,5
7	1	1	0	1	1	1	3	2	1	0	0	0	0	3,5
13	1	2	1	1	1	0	0	0	0	0	0	1	1	5,5
16	1	0	0	0	0	1	2	1	1	1	1	0	3	1,5
25	1	0	1	0	0	0	1	1	0	1	1	1	2	1,5
11	2	2	0	0	0	1	3	0	1	1	1	0	0	4,5
12	2	0	1	1	1	0	1	1	0	0	0	1	2	2,5
14	2	0	0	1	1	1	2	1	1	0	0	0	3	2,5
21	2	1	1	0	0	0	0	2	0	1	1	1	1	1,5
8	3	2	0	0	0	0	1	0	1	1	1	1	2	0,5
9	3	0	0	1	1	0	0	1	1	0	0	1	1	0,5
10	3	0	1	1	1	1	3	1	0	0	0	0	0	1,5
18	3	1	1	0	0	1	2	2	0	1	1	0	3	0,5
3	4	1	0	0	1	0	3	2	1	1	0	1	0	7,5
4	4	0	0	1	0	0	2	1	1	0	1	1	3	1,5
17	4	0	1	1	0	1	1	1	0	0	1	0	2	2,5

19	4	2	1	0	1	1	0	0	0	1	0	0	1	5,5
1	5	0	0	1	0	1	0	1	1	0	1	0	1	0,5
2	5	2	1	0	1	0	2	0	0	1	0	1	3	3,5
5	5	1	0	0	1	1	1	2	1	1	0	0	2	0,5
24	5	0	1	1	0	0	3	1	0	0	1	1	0	5,5
6	6	0	0	0	1	1	0	1	1	1	0	0	1	0,5
15	6	0	1	0	1	0	3	1	0	1	0	1	0	5,5
23	6	1	1	1	0	0	2	2	0	0	1	1	3	0,5
29	6	2	0	1	0	1	1	0	1	0	1	0	2	3,5
26	7	0	1	0	1	1	1	1	0	1	0	0	2	2,5
27	7	2	0	1	0	0	3	0	1	0	1	1	0	4,5
30	7	1	1	1	0	1	0	2	0	0	1	0	1	2,5
31	7	0	0	0	1	0	2	1	1	1	0	1	3	1,5
Scenario 2	Blocking	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	
20	0	0	0	0	0	0	0	2	1	1	1	1	1	4,5
22	0	1	0	1	1	0	1	0	1	0	0	1	2	2,5
28	0	2	1	1	1	1	2	1	0	0	0	0	3	6,5
32	0	0	1	0	0	1	3	2	0	1	1	0	0	6,5
7	1	1	0	1	1	1	3	0	1	0	0	0	0	1,5
13	1	2	1	1	1	0	0	1	0	0	0	1	1	4,5
16	1	0	0	0	0	1	2	2	1	1	1	0	3	2,5
25	1	0	1	0	0	0	1	2	0	1	1	1	2	2,5
11	2	2	0	0	0	1	3	1	1	1	1	0	0	5,5
12	2	0	1	1	1	0	1	2	0	0	0	1	2	1,5
14	2	0	0	1	1	1	2	2	1	0	0	0	3	1,5

21	2	1	1	0	0	0	0	0	0	1	1	1	1	0,5
8	3	2	0	0	0	0	1	1	1	1	1	1	2	1,5
9	3	0	0	1	1	0	0	2	1	0	0	1	1	0,5
10	3	0	1	1	1	1	3	2	0	0	0	0	0	2,5
18	3	1	1	0	0	1	2	0	0	1	1	0	3	2,5
3	4	1	0	0	1	0	3	0	1	1	0	1	0	5,5
4	4	0	0	1	0	0	2	2	1	0	1	1	3	2,5
17	4	0	1	1	0	1	1	2	0	0	1	0	2	1,5
19	4	2	1	0	1	1	0	1	0	1	0	0	1	4,5
1	5	0	0	1	0	1	0	2	1	0	1	0	1	0,5
2	5	2	1	0	1	0	2	1	0	1	0	1	3	2,5
5	5	1	0	0	1	1	1	0	1	1	0	0	2	2,5
24	5	0	1	1	0	0	3	2	0	0	1	1	0	6,5
6	6	0	0	0	1	1	0	2	1	1	0	0	1	0,5
15	6	0	1	0	1	0	3	2	0	1	0	1	0	6,5
23	6	1	1	1	0	0	2	0	0	0	1	1	3	2,5
29	6	2	0	1	0	1	1	1	1	0	1	0	2	2,5
26	7	0	1	0	1	1	1	2	0	1	0	0	2	1,5
27	7	2	0	1	0	0	3	1	1	0	1	1	0	5,5
30	7	1	1	1	0	1	0	0	0	0	1	0	1	4,5
31	7	0	0	0	1	0	2	2	1	1	0	1	3	2,5
Scenario 3	Blocking	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	
20	0	0	0	0	0	0	0	1	1	1	1	1	2	2
22	0	1	0	1	1	0	1	2	1	0	0	1	3	2
28	0	2	1	1	1	1	2	0	0	0	0	0	0	3

32	0	0	1	0	0	1	3	1	0	1	1	0	1	4
7	1	1	0	1	1	1	3	2	1	0	0	0	1	2
13	1	2	1	1	1	0	0	0	0	0	0	1	2	7
16	1	0	0	0	0	1	2	1	1	1	1	0	0	6
25	1	0	1	0	0	0	1	1	0	1	1	1	3	0
11	2	2	0	0	0	1	3	0	1	1	1	0	1	3
12	2	0	1	1	1	0	1	1	0	0	0	1	3	4
14	2	0	0	1	1	1	2	1	1	0	0	0	0	2
21	2	1	1	0	0	0	0	2	0	1	1	1	2	0
8	3	2	0	0	0	0	1	0	1	1	1	1	3	1
9	3	0	0	1	1	0	0	1	1	0	0	1	2	2
10	3	0	1	1	1	1	3	1	0	0	0	0	1	0
18	3	1	1	0	0	1	2	2	0	1	1	0	0	4
3	4	1	0	0	1	0	3	2	1	1	0	1	1	6
4	4	0	0	1	0	0	2	1	1	0	1	1	0	6
17	4	0	1	1	0	1	1	1	0	0	1	0	3	4
19	4	2	1	0	1	1	0	0	0	1	0	0	2	7
1	5	0	0	1	0	1	0	1	1	0	1	0	2	2
2	5	2	1	0	1	0	2	0	0	1	0	1	0	1
5	5	1	0	0	1	1	1	2	1	1	0	0	3	2
24	5	0	1	1	0	0	3	1	0	0	1	1	1	4
6	6	0	0	0	1	1	0	1	1	1	0	0	2	2
15	6	0	1	0	1	0	3	1	0	1	0	1	1	4
23	6	1	1	1	0	0	2	2	0	0	1	1	0	4
29	6	2	0	1	0	1	1	0	1	0	1	0	3	5
26	7	0	1	0	1	1	1	1	0	1	0	0	3	4

27	7	2	0	1	0	0	3	0	1	0	1	1	1	3
30	7	1	1	1	0	1	0	2	0	0	1	0	2	4
31	7	0	0	0	1	0	2	1	1	1	0	1	0	6
Scenario 4	Blocking	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	
20	0	0	0	0	0	0	0	2	1	1	1	1	2	3
22	0	1	0	1	1	0	1	0	1	0	0	1	3	4
28	0	2	1	1	1	1	2	1	0	0	0	0	0	2
32	0	0	1	0	0	1	3	2	0	1	1	0	1	5
7	1	1	0	1	1	1	3	0	1	0	0	0	1	0
13	1	2	1	1	1	0	0	1	0	0	0	1	2	6
16	1	0	0	0	0	1	2	2	1	1	1	0	0	7
25	1	0	1	0	0	0	1	2	0	1	1	1	3	1
11	2	2	0	0	0	1	3	1	1	1	1	0	1	4
12	2	0	1	1	1	0	1	2	0	0	0	1	3	3
14	2	0	0	1	1	1	2	2	1	0	0	0	0	3
21	2	1	1	0	0	0	0	0	0	1	1	1	2	2
8	3	2	0	0	0	0	1	1	1	1	1	1	3	0
9	3	0	0	1	1	0	0	2	1	0	0	1	2	1
10	3	0	1	1	1	1	3	2	0	0	0	0	1	1
18	3	1	1	0	0	1	2	0	0	1	1	0	0	2
3	4	1	0	0	1	0	3	0	1	1	0	1	1	4
4	4	0	0	1	0	0	2	2	1	0	1	1	0	7
17	4	0	1	1	0	1	1	2	0	0	1	0	3	3
19	4	2	1	0	1	1	0	1	0	1	0	0	2	6
1	5	0	0	1	0	1	0	2	1	0	1	0	2	1

2	5	2	1	0	1	0	2	1	0	1	0	1	0	2
5	5	1	0	0	1	1	1	0	1	1	0	0	3	4
24	5	0	1	1	0	0	3	2	0	0	1	1	1	5
6	6	0	0	0	1	1	0	2	1	1	0	0	2	1
15	6	0	1	0	1	0	3	2	0	1	0	1	1	5
23	6	1	1	1	0	0	2	0	0	0	1	1	0	2
29	6	2	0	1	0	1	1	1	1	0	1	0	3	4
26	7	0	1	0	1	1	1	2	0	1	0	0	3	3
27	7	2	0	1	0	0	3	1	1	0	1	1	1	4
30	7	1	1	1	0	1	0	0	0	0	1	0	2	6
31	7	0	0	0	1	0	2	2	1	1	0	1	0	7
Scenario 5	Blocking	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	
20	0	0	0	0	0	0	0	1	1	1	1	1	3	0,5
22	0	1	0	1	1	0	1	2	1	0	0	1	0	2,5
28	0	2	1	1	1	1	2	0	0	0	0	0	1	4,5
32	0	0	1	0	0	1	3	1	0	1	1	0	2	2,5
7	1	1	0	1	1	1	3	2	1	0	0	0	2	0,5
13	1	2	1	1	1	0	0	0	0	0	0	1	3	8,5
16	1	0	0	0	0	1	2	1	1	1	1	0	1	4,5
25	1	0	1	0	0	0	1	1	0	1	1	1	0	4,5
11	2	2	0	0	0	1	3	0	1	1	1	0	2	1,5
12	2	0	1	1	1	0	1	1	0	0	0	1	0	0,5
14	2	0	0	1	1	1	2	1	1	0	0	0	1	0,5
21	2	1	1	0	0	0	0	2	0	1	1	1	3	1,5
8	3	2	0	0	0	0	1	0	1	1	1	1	0	3,5

9	3	0	0	1	1	0	0	1	1	0	0	1	3	3,5
10	3	0	1	1	1	1	3	1	0	0	0	0	2	1,5
18	3	1	1	0	0	1	2	2	0	1	1	0	1	2,5
3	4	1	0	0	1	0	3	2	1	1	0	1	2	4,5
4	4	0	0	1	0	0	2	1	1	0	1	1	1	4,5
17	4	0	1	1	0	1	1	1	0	0	1	0	0	0,5
19	4	2	1	0	1	1	0	0	0	1	0	0	3	8,5
1	5	0	0	1	0	1	0	1	1	0	1	0	3	3,5
2	5	2	1	0	1	0	2	0	0	1	0	1	1	0,5
5	5	1	0	0	1	1	1	2	1	1	0	0	0	2,5
24	5	0	1	1	0	0	3	1	0	0	1	1	2	2,5
6	6	0	0	0	1	1	0	1	1	1	0	0	3	3,5
15	6	0	1	0	1	0	3	1	0	1	0	1	2	2,5
23	6	1	1	1	0	0	2	2	0	0	1	1	1	2,5
29	6	2	0	1	0	1	1	0	1	0	1	0	0	0,5
26	7	0	1	0	1	1	1	1	0	1	0	0	0	0,5
27	7	2	0	1	0	0	3	0	1	0	1	1	2	1,5
30	7	1	1	1	0	1	0	2	0	0	1	0	3	5,5
31	7	0	0	0	1	0	2	1	1	1	0	1	1	4,5
Scenario 6	Blocking	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	Speed	Limit	Quality	Turkey	S. Cyprus	Add. Cost	
20	0	0	0	0	0	0	0	2	1	1	1	1	3	1,5
22	0	1	0	1	1	0	1	0	1	0	0	1	0	0,5
28	0	2	1	1	1	1	2	1	0	0	0	0	1	3,5
32	0	0	1	0	0	1	3	2	0	1	1	0	2	3,5
7	1	1	0	1	1	1	3	0	1	0	0	0	2	1,5

13	1	2	1	1	1	0	0	1	0	0	0	1	3	7,5
16	1	0	0	0	0	1	2	2	1	1	1	0	1	5,5
25	1	0	1	0	0	0	1	2	0	1	1	1	0	5,5
11	2	2	0	0	0	1	3	1	1	1	1	0	2	2,5
12	2	0	1	1	1	0	1	2	0	0	0	1	0	1,5
14	2	0	0	1	1	1	2	2	1	0	0	0	1	1,5
21	2	1	1	0	0	0	0	0	0	1	1	1	3	3,5
8	3	2	0	0	0	0	1	1	1	1	1	1	0	4,5
9	3	0	0	1	1	0	0	2	1	0	0	1	3	2,5
10	3	0	1	1	1	1	3	2	0	0	0	0	2	0,5
18	3	1	1	0	0	1	2	0	0	1	1	0	1	0,5
3	4	1	0	0	1	0	3	0	1	1	0	1	2	2,5
4	4	0	0	1	0	0	2	2	1	0	1	1	1	5,5
17	4	0	1	1	0	1	1	2	0	0	1	0	0	1,5
19	4	2	1	0	1	1	0	1	0	1	0	0	3	7,5
1	5	0	0	1	0	1	0	2	1	0	1	0	3	2,5
2	5	2	1	0	1	0	2	1	0	1	0	1	1	0,5
5	5	1	0	0	1	1	1	0	1	1	0	0	0	0,5
24	5	0	1	1	0	0	3	2	0	0	1	1	2	3,5
6	6	0	0	0	1	1	0	2	1	1	0	0	3	2,5
15	6	0	1	0	1	0	3	2	0	1	0	1	2	3,5
23	6	1	1	1	0	0	2	0	0	0	1	1	1	0,5
29	6	2	0	1	0	1	1	1	1	0	1	0	0	0,5
26	7	0	1	0	1	1	1	2	0	1	0	0	0	1,5
27	7	2	0	1	0	0	3	1	1	0	1	1	2	2,5
30	7	1	1	1	0	1	0	0	0	0	1	0	3	7,5

31	7	0	0	0	1	0	2	2	1	1	0	1	1	5,5

Appendix B: Survey Questionnaire

FIELD SURVEY FOR

MOBILE TELECOMMUNICATIONS USE AND DEMAND FOR SERVICE IMPROVEMENTS IN TRNC

This survey is being conducted for use in an ongoing dissertation research project at Eastern Mediterranean University Economics Department, on the topic of mobile telecommunications use and demand for service improvements (such as 4G and cost-free use when abroad) in TRNC.

Section 1: Mobile Phone and Internet Use

1. Which mobile telecommunications devices listed below do you possess? (Please check all that apply)

a. Regular mobile phone [ ]

b. Smart phone (iPhone, Samsung Galaxy and likes) [ ]

c. Tablet (iPad and likes) [ ]

d. Laptop [ ]

2. Do you possess any personal GSM numbers/sim cards (registered in TRNC) which you use in your mobile devices?

a. Yes I do [ ] ....How many?: _______________ number(s)

b. No I don't [ ]

If your response to Question 2 is "No I don't", please continue with Question 21.

3. How much do you pay monthly on average for your personal GSM number? If you own more than one number, please write seperately the monthly amount you pay for each of your GSM numbers. (Inclusive of mobile speaking, SMS, internet service costs and taxes)

Please write: _______ TL per month (for my primary GSM number)

_______ TL per month (for my 2nd GSM number)

_______ TL per month (for my 3rd GSM number)

4. How frequently do you use the <u>mobile internet</u> service provided by your GSM subscription?

a. Every day [ ]

b. Several times a week [ ]

c. Several times a month [ ]

d. Very rarely [ ]

e. Never [ ]

If your response to Question 4 is “Never”, please continue with Question 9.

5. For which purposes do you use the mobile internet service provided by your GSM subscription? (Please check all that apply)

a. Search engines (e.g. Google) [ ]

b. E-mail [ ]

c. Instant messaging (e.g. WhatsApp) [ ]

d. Voice over IP (speaking on the internet) [ ]

e. Videophone (speaking on the internet with video) [ ]

f. Social networking sites (e.g. Facebook, Twitter, Instagram) [ ]

g. News sites [ ]

h. Watching videos [ ]

i. Watching movies [ ]

j. Other mobile applications (e.g. downloaded from App Store) [ ]

k. Cloud computing (i.e. storing personal documents over the net) [ ]

l. To connect my laptop/computer to the internet wirelessly [ ]

6. For how many hours per week on average do you use the mobile internet service provided by your GSM subscription?

Please write: _______________ hours per week

7. How do you purchase the mobile internet service provided by your GSM subscription?

a. Monthly flat-sum plan (I buy a mobile internet package with a data limit) [ ]

b. Meter-rate billing plan (I pay as much as I use) [ ]

If your response to Question 7 is "Meter-rate billing plan", please continue with Question 9.

8. What is the data limit of the mobile internet package you have on your GSM subscription?

Please write: _______________ MB/GB per month

9. Do you experience any problems with your GSM services such as noise/disconnection when speaking, or slowing/freezing/not connecting with your mobile internet?

a. Yes I do [ ]

b. No I don't [ ]

If your response to Question 9 is "No I don't", please continue with Question 11.

10. How frequently do you face the problems mentioned in Question 9?

a. Every day [ ]

b. Once or several times a week [ ]

c. Once or several times a month [ ]

d. Once every few months [ ]

e. Never [ ]

11. Speaking or using mobile internet in Turkey with your TRNC GSM number/subscription are subject to "roaming" costs. How frequently do you travel to Turkey? Please write the average number of days which you are in Turkey in one year.

Please write: _______________ days on average, in one year

12. Suppose it was possible to speak and use mobile internet in Turkey with your current TRNC GSM subcription, number and plan. Would you be interested?

a. Yes I would be interested [ ]

b. No I wouldn't be interested [ ]

13. Speaking or using mobile internet in South Cyprus with your TRNC GSM number/subscription is not possible due to the current political problem (except for regions which are close to the Northern border and have signal coverage from transmitters in the North). How frequently do you travel to South Cyprus? Please write the average number of days which you are in South Cyprus in one year.

Please write: _______________ days on average, in one year

14. Suppose it was possible to speak and use mobile internet in South Cyprus with your current North Cyprus GSM subscription, number and plan. Would you be interested?

a. Yes I would be interested [ ]

b. No I wouldn’t be interested [ ]

Section 2: Willingness to Pay for 4G

Fourth generation mobile communications technology, known as 4G, is a new technology which enables both high-quality voice conversation and very high speed mobile internet connectivity. 4G mobile internet has a minimum connection speed of 30 Mbit/s, and it is capable of providing speeds up to 300 Mbit/s. The 3G technology currently in use in TRNC provides an average speed of 3 Mbit/s. This means **4G mobile internet is 10 to 100 times faster than 3G mobile internet**.

"Very high speed" mobile internet connectivity provided by 4G technology will make it possible to take advantage of the following:

- Mobile "videophone" conversations can be made.
- Videos and movies on the internet will display instantly.
- Real-time games on the internet can be played while mobile.
- No freezing/disconnection in the video/movie/game stream while on the move. (e.g. travelling in a car)
- Very large file transfers can be made instantly over the internet.
- Cloud computing can be used while mobile. With the very high speed mobile internet connectivity, all personal files can be stored on the internet and displayed on all personal mobile devices.
- Because 4G mobile internet service can be used for home internet connection as well, you may opt not to purchase a seperate home internet service.

Another advantage of the 4G technology when compared with 3G, is that **4G is better in quality, in other words 4G provides a higher quality voice conversation and mobile internet connection capability**. 4G users never experience any freezing or disconnection while speaking on their mobile phone or surfing the internet.

In order for 4G technology to be available in TRNC, investments need to be made to build the infrastructure. In order to elaborate on the investments to make, the returns of the 4G for the people of TRNC should be established. This section aims to quantify the monetary value of 4G for the consumer.

Note 1: Please respond to the question below, considering only your own needs and your own budget.

Note 2: The purpose of this survey is only academic. It is not being administered by the government or by any private firm for pricing 4G. Your responses will not affect any possible 4G prices in the future.

15. Would you be willing to pay for a 4G service which provides **mobile internet speed 10 times faster than 3G, unlimited internet use, and no freezing/disconnection in speaking or internet connectivity**, if the additional cost on your monthly GSM bill (per subscription) were...

<table>
<tr><td rowspan="12">Put a tick [✓] next to the HIGHEST amount that you are sure you would pay.

Put a cross [×] next to the FIRST amount that you are sure you would not pay.</td><td></td><td>Additional cost on monthly GSM bill</td><td></td></tr>
<tr><td>1.</td><td>Would not go for 4G.</td><td>[ ]</td></tr>
<tr><td>2.</td><td>5 TL additional per month</td><td>[ ]</td></tr>
<tr><td>3.</td><td>10 TL additional per month</td><td>[ ]</td></tr>
<tr><td>4.</td><td>15 TL additional per month</td><td>[ ]</td></tr>
<tr><td>5.</td><td>20 TL additional per month</td><td>[ ]</td></tr>
<tr><td>6.</td><td>25 TL additional per month</td><td>[ ]</td></tr>
<tr><td>7.</td><td>30 TL additional per month</td><td>[ ]</td></tr>
<tr><td>8.</td><td>40 TL additional per month</td><td>[ ]</td></tr>
<tr><td>9.</td><td>50 TL additional per month</td><td>[ ]</td></tr>
<tr><td>10.</td><td>70 TL additional per month</td><td>[ ]</td></tr>
<tr><td>11.</td><td>100 TL additional per month</td><td>[ ]</td></tr>
</table>

	12.	150 TL additional per month	[ ]
	13.	200 TL additional per month	[ ]
	14.	300 TL additional per month	[ ]
	15.	More than 300 TL per month Minimum WTP: _____TL per month Maximum WTP: _____TL per month	[ ]

If your response to Question 17 is "Would not go for 4G", please continue with Question 18. If not, please continue with Section 3.

16. What are the reasons that you would not go for 4G?

Please write:

____

____

____

Section 3: Willingness to Pay for Alternative Mobile Telecommunication Services

This section aims to quantify your willingness to pay for improvements in mobile telecommunication services. You will be asked to make choices among services with varying attributes. The attributes that alternative services possess are described below:

Attribute	**Description**	**Levels**
Internet speed	Describes mobile internet speed	Present speed (3 Mbit/s)
		10 times faster (30 Mbit/s)
		100 times faster (300 Mbit/s)
Internet limit	Describes unlimited use of mobile internet without additional cost	Limited/meter-rate (high extra costs with over use)
		Unlimited (unlimited use – no extra costs)
Quality	Describes the quality of voice conversation and mobile internet connectivity (as to whether freezing/slowing/disconnection occur)	Present level
		Better quality
Use in Turkey w/out roaming cost	Speaking and internet use in Turkey with TRNC number without roaming costs (using same plan as in TRNC)	No
		Yes
Use in South Cyprus w/out roaming cost	Speaking and internet use in South Cyprus with TRNC number without roaming costs (using same plan as in TRNC)	No
		Yes

Additional monthly cost	Additional monthly GSM cost per subscription	20 TL
		40 TL
		60 TL
		80 TL

Now you will be asked to make 4 service choices. You will be presented with 3 alternatives (A, B, C) in every choice question: 2 new mobile telecommunication services (A, B) and 1 current service you are actually using now (C). The 2 new services will have varying levels for the attributes listed above. Your current service, to remind you, has the following attribute levels:

1. Current service internet speed: Present speed (The only mobile technology currently available in TRNC is 3G)

2. Current service internet limit: Limited/meter-rate (Current GSM operators in TRNC have no plans or packages which offer unlimited mobile internet use)

3. Current service internet quality: Present level

4. Use in Turkey w/out roaming cost with current service: No

5. Use in South Cyprus w/out roaming cost with current service: No

6. Additional monthly cost: 0 TL (No additional cost because it's the current service)

Please make every choice as you would do if you faced a similar situation in real life. If you prefer one of the new services please select that service, or if you prefer to stay with your current service please select the current service.

(Note: In order to comprehend the amount of mobile internet offered by a "limited/meter-rate" service, you may consider it will be similar to the "limited/meter-rate" experience you have with your current service.)

17. Among 3 alternative mobile telecommunication services listed below (Service A, Service B and Service C), please choose the one you prefer.

	Service A	Service B	Service C (Current Service)
Internet speed	10 times faster	Present speed	Present speed
Internet limit	Unlimited	Limited/meter-rate	Limited/meter-rate
Quality (voice and internet)	Better quality	Present level	Present level
Use in Turkey w/out roaming cost	No	Yes	No
Use in S. Cyprus w/out roaming cost	No	Yes	No
Additional monthly cost	80 TL	60 TL	0 TL
Your choice:	[ ]	[ ]	[ ]

18. Among 3 alternative mobile telecommunication services listed below (Service A, Service B and Service C), please choose the one you prefer.

	Service A	Service B	Service C (Current Service)
Internet speed	Present speed	10 times faster	Present speed
Internet limit	Unlimited	Limited/meter-rate	Limited/meter-rate
Quality (voice and internet)	Present level	Better quality	Present level
Use in Turkey w/out roaming cost	Yes	No	No
Use in S. Cyprus w/out roaming cost	Yes	No	No
Additional monthly cost	60 TL	40 TL	0 TL
Your choice:	[ ]	[ ]	[ ]

19. Among 3 alternative mobile telecommunication services listed below (Service A, Service B and Service C), please choose the one you prefer.

	Service A	Service B	Service C (Current Service)
Internet speed	Present speed	10 times faster	Present speed
Internet limit	Limited/meter-rate	Unlimited	Limited/meter-rate
Quality (voice and internet)	Present level	Better quality	Present level
Use in Turkey w/out roaming cost	No	Yes	No
Use in S. Cyprus w/out roaming cost	No	Yes	No
Additional monthly cost	20 TL	80 TL	0 TL
Your choice:	[ ]	[ ]	[ ]

20. Among 3 alternative mobile telecommunication services listed below (Service A, Service B and Service C), please choose the one you prefer.

	Service A	Service B	Service C (Current Service)
Internet speed	10 times faster	Present speed	Present speed
Internet limit	Limited/meter-rate	Unlimited	Limited/meter-rate
Quality (voice and internet)	Better quality	Present level	Present level
Use in Turkey w/out roaming cost	Yes	No	No
Use in S. Cyprus w/out roaming cost	Yes	No	No
Additional monthly cost	40 TL	20 TL	0 TL
Your choice:	[ ]	[ ]	[ ]

Section 4: Demographic Questions

21. District: a. Girne [ ] b. G.yurt [ ] c. İskele [ ] d. Lefkoşa [ ] e. Mağusa [ ]

22. Your age: _______________ (please write)

23. Your gender: a. Female [ ] b. Male [ ]

24. Your marital status: a. Married [ ] b. Not married [ ]

25. Your education: a. Primary school [ ] b. Secondary school [ ] c. High school / Vocational [ ] d. University (2-year) [ ] e. University (4-year) [ ] f. Graduate school (Master) [ ] g. Graduate school (Doctorate) [ ]

26. Employment: a. Employed [ ] b. Unemployed [ ]

27. Your net monthly income (After-tax net income inclusive of your wage, family contributions, state contributions, rents and returns on investment):

_______________ TL per month

28. Nationality: a. Only TRNC [ ] b. Dual (TRNC and other) [ ] c. Other [ ]

THE END

THANK YOU FOR YOUR VALUABLE TIME.

Section 5: Post Interview (For interviewer only)

Please rate the quality of the interview based on the concentration of the person to be interviewed, attentiveness to the questions, and number of questions answered:

a. Very good [ ]

b. Good [ ]

c. Fair [ ]

d. Poor [ ]

e. Very poor [ ]

Name of the interviewer: ....

Date of interview: ....

Time started: ....

Duration of the interview: ....