Islamic University of Gaza
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الجامعة الإسلامية – غزة
عمادة الدراسات العليا
كلية التجارة
قسم إدارة الأعمال

Developing a Forecasting Model for Mobile Users in Palestine

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A Thesis Presented in Partial Fulfillment of the Requirement for

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تطوير نموذج تنبؤ لمستخدمي الهاتف الخلوي في فلسطين

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بسم الله الرحمن الرحيم

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The Islamic University - Gaza

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نتيجة الحكم على أطروحة ماجستير

بناءً على موافقة عمادة الدراسات العليا بالجامعة الإسلامية بغزة على تشكيل لجنة الحكم على أطروحة الباحث/ **حسن سعيد الهندي** لنيل درجة الماجستير في **كلية *التجارة*/ قسم إدارة الأعمال** وموضوعها:

"Developing a Forecasting Model for Mobile Users in Palestine"

وبعد المناقشة العلنية التي تمت اليوم الثلاثاء 12 شوال 1428هـ، الموافق 2007/10/23م الساعة الواحدة ظهراً، اجتمعت لجنة الحكم على الأطروحة والمكونة من:

أ.د. يوسف عاشور	**مشرفاً ورئيساً**	.....
د. سمير صافي	**مشرفاً**	.....
أ.د. رفعت رستم	**مناقشاً داخلياً**	.....
د. محمد مقداد	**مناقشاً داخلياً**	.....

وبعد المداولة أوصت اللجنة بمنح الباحث درجة الماجستير في **كلية *التجارة*/قسم إدارة الأعمال.**

واللجنة إذ تمنحه هذه الدرجة فإنها توصيه بتقوى الله ولزوم طاعته وأن يسخر علمه في خدمة دينه ووطنه.

والله ولي التوفيق ،،،

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بسم الله الرحمن الرحيم

Abstract

The aim of this research is to develop a forecasting model for the number of mobile users and explore their diffusion pattern customized to the Palestinian market which experiences unusual circumstances and faces a series of obstacles and uncertainties.

The main approach follows an objective, statistically based method to develop the model. Nevertheless, a questionnaire was used to support the statistical model and help in answering some of the research objectives.

Using a historical time-series data of mobile users, a multiple regression method is implemented to build two model scenarios. Fist scenario explores the effect of some variables on the diffusion pattern such as GDP, Competition, Technology and Fixed phone lines. Second scenario incorporates the potential population into account.

It is shown that the mobile diffusion in the Palestinian market follows an S-shaped curve. It is found that GDP per capita did not show a significant effect on mobile diffusion in both model scenarios. Meanwhile, the competition effect was the most significant. Also, it is found that the transition occurred at year 1999 from the analogue to digital technology has a considerable impact on the diffusion of mobile users. It is also found that Mobile and Fixed phones are complements. Hence more fixed lines, the greater the growth of Mobile.

First scenario model shows that the penetration rate will be some 27.6% in 2016 meanwhile the second scenario expects a penetration of 40.2% in 2016.

The researcher expects introducing 3G services by end of year 2008 unless there are external obstacles due to political situation and difficulties in achieving the required frequencies of 3G systems.

Future research can utilize other tools such as logistic fit and extrapolating the curve to forecast the future.

ملخص الرسالة

يهدف البحث بشكل أساسي إلى تطوير نموذج تنبؤ لمستخدمي الهاتف الخلوي و استكشاف نمط الانتشار بما يتناسب مع السوق الفلسطيني الذي يعاني من ظروف غير اعتيادية ويواجه عدة عوائق وحالات من عدم التأكد.

و قد اعتمد البحث على منهجية بحوث العمليات وبناء النماذج إحصائياً لتطوير النموذج المطلوب . ومع ذلك، فقد تم استخدام الاستبانة أيضا لتعزيز نتائج النموذج الإحصائي والمساهمة في الإجابة على بعض أهداف البحث.

لقد تم تطوير نموذجين من خلال طريقة الانحدار المتعدد للبيانات بالاستفادة من البيانات التاريخية ذات السلاسل الزمنية عن مستخدمي الهاتف الخلوي . النموذج الأول يستكشف تأثير بعض العوامل والمتغيرات على حجم الانتشار للهاتف الخلوي مثل الدخل القومي للفرد، والمنافسة والتكنولوجيا المستخدمة والخطوط العاملة في الهاتف الأرضي. النموذج الثاني يأخذ بعين الاعتبار النمو السكاني المتزايد ضمن مساحة التغطية والخدمة .

لقد أوضحت الدراسة أن انتشار الهاتف الخلوي في السوق الفلسطيني يتبع النمط العام على شكل الحرف "S". كما تبين أن معدل الدخل القومي للفرد لم يكن له تأثير واضح على انتشار الهاتف الخلوي في كلا النموذجين. كذلك وجد أن التحول في التكنولوجيا المستخدمة و الذي حدث في بداية سنة 1999 من النظام الخلوي القديم إلى النظام الرقمي الجديد كان له تأثير ملحوظ على انتشار الهاتف الخلوي. كما وجد أن الهاتف الخلوي في حالة تكامل مع الهاتف الأرضي بمعنى أنه بزيادة خطوط الهاتف الأرضي، كان هناك زيادة في الهاتف الخلوي.

النموذج الأول أظهر أن معدل الانتشار بالنسبة لعدد السكان من المتوقع أن يصل إلى 27.6% في عام 2016م بينما النموذج الثاني يتوقع نسبة انتشار تصل إلى 40.2% في عام 2016م.

أظهر البحث أنه من المتوقع أن يتم البدء في انتشار وتقديم خدمات الجيل الثالث مع نهاية عام 2008 ما لم تحدث عوائق خارجية نظراً للوضع السياسي والصعوبات في الحصول على الترددات اللازمة.

أخيراً فإن الباحث يوصي بالقيام بدراسة تتناول مستقبل الانتشار للهاتف الخلوي باستخدام وسائل أخرى مثل ملائمة المنحنى اللوجستي (Logistic Fit) و إستقرائه في عملية التنبؤ بالمستقبل .

Acknowledgments

I would like to acknowledge my academic supervisors, Prof. Dr. Yousif Ashour and Dr. Samir Safi for their support, advice and direction throughout this dissertation. Without such kind support and supervision the emergence of this dissertation would have been next to impossible.

I would also like to thank my examiners', Dr. Refat Rustom and Dr. Mohammad Meqdad, for their efforts and valuable remarks and notes.

Special thanks to those noble people who help me in distributing and collecting the questionnaire over the 16 governorates especially in West Bank in such difficulties in mobility.

Finally, I would like to thank my colleagues in the MBA program for their encouragement and support, and also my job colleagues in Paltel and Jawwal for their intellectual encouragement and support.

Dedication

I dedicate this work to my people of Palestine.

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Abbreviations

2.5G	It extends 2G of mobile telephony systems.
2G	The second generation of mobile telephony systems.
3G	Third generation technology.
ARPU	Average Revenue Per User
CAGR	Compound Annual Growth Rate
CDMA	Code Division Multiple Access.
CEL	Total number of cellular mobile users in Palestinian Market
CMP	Competition presence in Palestinian Cellular Market, Yes/No.
DIG	Network type availability, Digital/Analogue/Mix
FDI	Foreign Direct Investment
FIX	Total number of Fixed telephone lines working in Palestinian Market
GDP	Gross Domestic Product in US dollars
GPRS	General Packet Radio Service.
GSM	Global System for Mobile Communications
HSDPA	High Speed Downlink Packet Access
ICT	Information and Communications Technology
ITU	International Telecommunications Union.
LICI	Lower Individual Confidence Interval
MMS	Multimedia Messaging Service.
MTIT	Ministry of Telecommunications and Information Technology
OECD	Organization for Economic Co-operation and Development
PALTEL	Palestinian Telecommunications Company C.O.
PCBS	Palestinian Central Bureau of Statistics
SFI	Subscription Free Internet
SMS	Short Message Service.
TDMA	Time Division Multiple Access.
UICI	Upper Individual Confidence Interval
WAP	Wireless Application Protocol.
WBG	West Bank and Gaza Strip
WTO	World Trade Organization

Glossary of Terms

2.5G 2.5G extends 2G systems, adding features such as packet-switched connection and enhanced data rates. 2.5G networks include EDGE and GPRS. These networks support WAP, MMS, SMS mobile games, and search and directory.

2G The second generation of mobile telephony systems uses digital encoding. 2G networks support high bit rate voice, limited data communications and different levels of encryption. 2G networks include GSM, and CDMA. 2G networks can support SMS applications.

3G The third generation of mobile systems provides high-speed data transmissions of 144Kbps and higher. 3G will support multimedia applications such as full-motion video, video conferencing and Internet access.

Analog Technology Transmission of a cellular call via radio waves. This was the first cellular means of transmitting cellular phone calls.

BSC Base station Controller
A transmission/reception station through which all the radio traffic of a cell passes. Communication signals are transported by lines or Hertzian packets.

BTS Base Transceiver Station
Technical term for a mobile radio base station. A BTS houses the transmitter and receiver equipment and antennae for a given radio cell. Several BTSs are administered by a single Base Station Controller (BSC), which in turn is under the control of a Mobile Switching Centre (MSC).

Cellular Operator	Represents the telecommunication company which provides mobile services. The terms "**cellular**" ,"**wireless**" and "**mobile**" are interchangeable
Digital Technology	Transmission of a cellular phone call by converting the analog signal into binary computer codes of 1s and 0s. Digital transmission increases the system capacity because it can transmit at least three times as many calls as analog. It also offers greater privacy.
EDGE	Enhanced Data Rates for GSM Evolution EDGE allows higher data transmission speeds based on the GSM standard. This system is sometimes referred to as "2.5G", to denote a halfway house between the GPRS-enhanced GSM technology and UMTS. Thanks to improved coding, data rates of up to 48,000 bits per channel are possible with EDGE. The acronym E-GPRS, also frequently used, stands for "Enhanced GPRS" = enhancement of the GPRS standard. When EDGE and GPRS are combined, data rates of up to 384 kilobits per second are possible.
E-mail	Short for electronic mail it refers to messages or information that are sent via the Internet
GDP	Gross domestic product. For a region, the GDP is "the market value of all the goods and services produced by labor and property located in" the region, usually a country. It is used as indicator for economic situation in a country.
GPRS	GPRS is a radio technology for GSM networks that adds packet-switching protocols. As a 2.5G technology, GPRS enables high-speed wireless Internet and other data communications. GPRS networks can deliver SMS, MMS, email, games and WAP applications.

GSM	Abbreviation for Global System for Mobile Communications. The uniform GSM standard ensures perfect compatibility between networks and mobile phones in any location. For example, a user in Switzerland can use his mobile phone to call or receive calls from Germany or Spain. The abbreviation originally stood for "Group Special Mobile", which was the name of the study group that developed a European standard for mobile networks in 1982. Today, this network is the result of their work - the standard for digital mobile telephony (now used all over the world). See UMTS.
ICT	Information and Communications Technology is a term used for the applications of modern communications and computing technologies to the creation, management and use of information.
MMS	Multimedia Messaging is based on the same principle as conventional SMS. Compared with the SMS, which is restricted to a maximum of 160 text characters and cannot exceed 160 bytes, up to 100 kilobytes of different types of data, such as text, short tunes, pictures, photos or brief video sequences, can be transmitted with MMS.
Mobile Users	Represents all active subscriptions or SIM cards used by subscribers. One subscriber can have multi-active subscriptions. The terms "**cellular**" ,"**wireless**" and "**mobile**" are interchangeable
OECD	The Organization for Economic Co-operation and Development, is an international organization of those developed countries that accept the principles of representative democracy and a free market economy. It includes 30 member countries mostly from Europe in addition to USA, Canada, Japan and Korea.
Penetration Rate	A percentage of total number of mobile lines in the market to total number of population.

Prepaid	A carrier program that lets subscribers prepay for wireless services. A useful feature for subscribers with credit limitations or who want to limit their billable time (or that of other users of the same phone).
RNC	Radio Network Controller; the element which controls the Node Bs within a UMTS network. It is roughly analogous to a BSC in a GSM network.
Service provider (Carrier)	A company that provides telephone (or another communications) service.
SIM	Subscriber Identity Module. It is an electronic chip contains subscription data and inserted in the mobile handset.
TDMA	Time Division Multiple Access; a technique for multiplexing multiple users onto a single channel on a single carrier by splitting the carrier into time slots and allocating these on a as-needed basis
UMTS	Universal Mobile Telecommunications System; the European entrant for 3G; now subsumed into the 3G family as the WCDMA technology.
WCDMA	Wideband CDMA; the technology created from a fusion of proposals to act as the European entrant for the ITU -3G family.

Chapter One

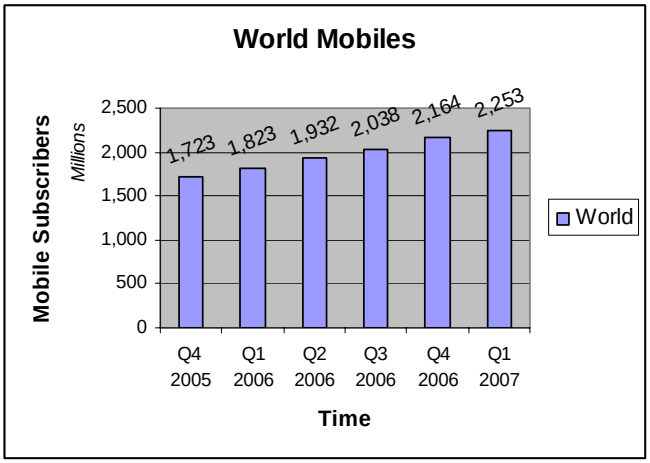
Research Background

1.1 Introduction.

Mobile Telecommunication services worldwide have experienced a rapid growth in the recent years. The diffusion of mobile telecommunication services was affected both by further technological innovations, such as the transition from analog to digital technology, and by regulatory decisions concerning spectrum licensing, competition and coordination to a common technical standard.

GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services. GSM differs from first generation wireless systems in that it uses digital technology and time division multiple access transmission methods. The mobile sector is now one of the most dynamic sectors in telecommunications. Fig.1.1 below shows that the world mobiles subscribers exceed 2.25 Billions by first quarter of 2007.

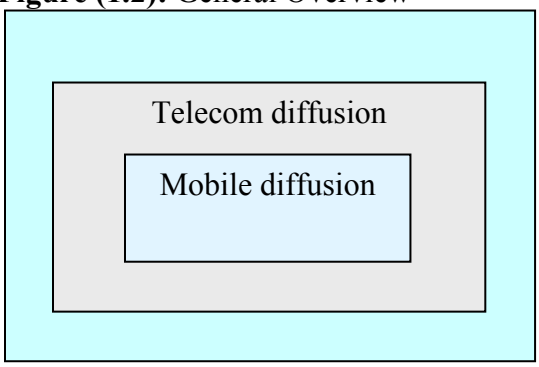
Figure (1.1): World GSM Mobiles growth.



Source : Adjusted from GSM Association 2007.

In fact, mobile diffusion can be viewed as a subset of telecom diffusion, which in turn is a subset of Information and Communications Technology (ICT) diffusion as shown in Fig.1.2 below.

Figure (1.2): General Overview



In Palestine, there are clear uncertainties in both economical and political situations. For example, between September 2000 and late 2002, the Palestinian economy experienced one of the deepest recessions in modern history. The decline in real per capita GDP reached almost 40% by the end of 2002. In 2006, the recession is back again as seen in Table 1.1. Unemployment increased from 10% of the workforce to an average of 41% during 2002, and the number of the poor rose from 20% to over 50% of the population. In Gaza, unemployment exceeded 46% of the workforce, and the poverty level rose to 68%. Private investment and trade fell dramatically through 2001 and 2002. Stabilization in 2003 resulted from factors which will may not be repeated (the return of US$294 million in tax revenues withheld in 2001 and 2002). *(World Bank report ,June 2004).*

In general, economic growth over the last fifteen years has been dismal, with the high population growth during most of this period (World Bank, Sep. 2006). Looking forward, economic prospects remain grim, and highly dependent on political outcomes.

Table (1.1): Macroeconomic Indicators for Palestine

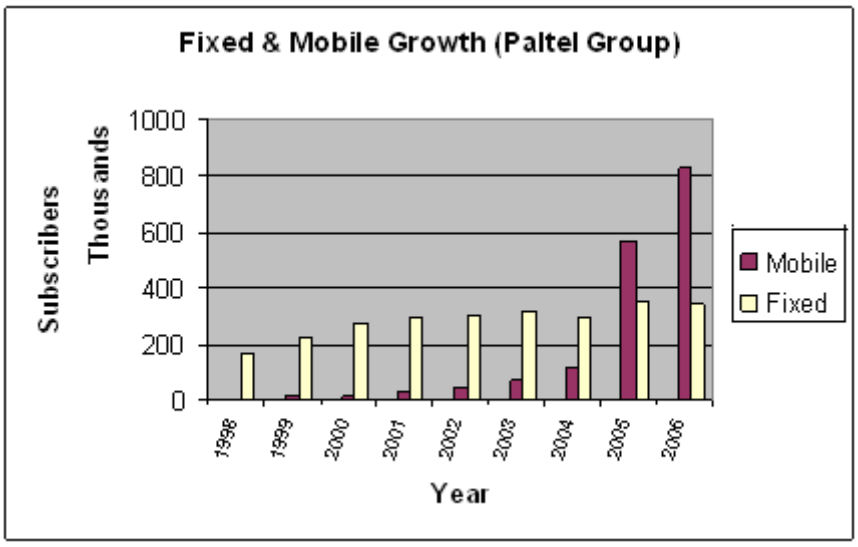
	1999	2000	2001	2002	2003	2004	2005	2006
(GDP), US$ million	4,179	4,116	3,329	2,831	3,144	3,609	4,044	2,910
GDP per capita, US$	1,493	1,409	1,087	879	925	1064	1,152	802
Real GDP growth rate	8.8%	-5.6%	-14.8%	-10.1%	6.1%	6.2%	6.3%	-24.5%
Poverty Rate	20%	27%	37%	51%	47%	46%	44%	67%
Unemployment Rate	12%	14%	26%	31%	26%	27%	23%	40%

Source: Adjusted from *World Bank report, June 2004 & September 2006*

As part of political uncertainties, the current security-oriented border regime – and access through the West Bank or Gaza to the borders –involves unpredictable delays, and uses inefficient methods which add considerably to transaction costs and make it impossible to fulfill import/export orders on time.

Nevertheless, the Palestinian telecom market is growing and becomes more regulated and competitive. Palestinian cellular operator, Jawwal, reported that it expanded its market share to more than 70% in Palestine's cellular market (Arab advisors, 2006). Fig.1.3 below shows the growth of Jawwal subscribers compared to fixed lines. Jawwal itself has excellent performance in 2006 reaching a total of about 830,000 subscribers by end of 2006.

Figure (1.3): Fixed & Mobile Growth (Paltel Group)



Source: Data from Ministry of Telecom. & Information Tech, Palestine

Recently, in March 2007, new license were granted by Palestinian National Authority for Second operator to build and operate GSM/3G network in West Bank and Gaza. The amount to be paid for this license is about US$ 355 millions, which is a clear significance for an expected fierce competition in the Palestinian telecom market.

Currently, Jawwal is the only Palestinian licensed service provider operating in West bank and Gaza strip since 1999. Nevertheless, there are subscribers for neighboring Israeli operators who are illegally operating in the market and competing with Jawwal operator.

Forecasting the diffusion of innovations in the telecommunications sector is a constantly recurring problem for national providers. An effective management of this diffusion process requires an understanding of the factors that underlie the evolution of the market. Factors such as market potential, timing and speed of adoption are of considerable importance for capacity planners. As the growth of the industry continuous through out the world, understanding the diffusion of cellular phones has become increasingly important. Consequently, the evolution of cellular phone markets, as well as their likely future trends, has been the subject of extensive research and analyses (Botelho, 2001).

The failure of many companies to produce reasonably accurate forecasts on which to base their plans has recently produced dramatic consequences (Fildes, 2002). This research is concerned with the forecasting of mobile subscribers and developing a diffusion pattern customized to the Palestinian market which experiences unusual circumstances and faces a series of obstacles and uncertainties.

Selection and implementation of a proper forecasting methodology is very important due to the fact that different forecasting problems must to be addressed using different tailored models to suit each problem.

In this research, an objective, statistically based method will be developed to estimate the market potential cellular mobile users in Palestine. More specifically, a time-series data on the number of subscribers will be used to examine the diffusion pattern of cellular phones in Palestine.

1.1.1 Research Problem

The main issue of this research is to develop a forecasting model to facilitate the answer of the main question of this research which is: **what will be the future of mobile sector growth in the Palestinian market in terms of subscribers and diffusion pattern.**

1.1.2 Research Variables

a) Dependent variable is the number of mobile users in Palestine and their diffusion pattern.

b) Independent variables, are the followings :

i. GDP per capita, which measures the Palestinian economic situation.

ii. Fixed phone lines, operation in West Bank & Gaza.

iii. Analogue/Digital system availability, which is a variable with three dimensions.

iv. Competition presence which is a dummy variable of two values, 0 and 1.

1.1.3 Research Hypotheses

The research has the following main hypotheses:

H 1. Higher GDP per capita accelerates the rate of the diffusion of mobile users.

H 2. More Fixed phone lines, increases the growth rate of mobile diffusion.

H 3. Digitalization, correlates positively with relative growth rate of mobile users.

H 4. Presence of competition correlates positively with the relative growth rate.

1.1.4 Research Objectives

The main objective of this research is to build and operate a diffusion model customized to the Palestinian telecom market which experiences unusual circumstances and faces a series of obstacles and uncertainties. This main objective of the research can be sub-divided into the following specific tasks:

A. To explore the factors which have affected the diffusion of Mobile Users in Palestine.

B. To study the effect of the following variables on the diffusion of Mobile Users:

- **I.** GDP per capita.
- **II.** Fixed Telephone Lines.
- **III.** Analog/ Digital systems.
- **IV.** Competition.

C. To develop a forecasting Model for Mobile diffusion customized to Palestinian market.

D. To forecast the diffusion of Mobile Users in Palestine for the next 10 years.

E. To discuss the implications on the diffusion of emerging third generation (3G) networks.

1.1.5 Research Importance

Information and Telecommunications technologies are regarded as one of the most important innovations in modern life. As it poses a great deal of impact on nations' economy as well as companies' competitiveness, technological innovations and their diffusion rises to the focal issues in terms of both enterprise strategies and government policies. Telecom market is in the core of this technological innovations and expanding rapidly.

In March.2007, a new license for a GSM/3G network has been granted by Palestinian National Authority (PNA) to end the monopoly of the telecom market in the Palestinian territories.

In such a dynamic environment, forecasting is critical to market success. Hence, it is extremely important for investors, planners and policy makers to predict the future of mobile telecom and its diffusion. Furthermore, the importance of this research arises from the lack of such an academic and quantitative research in the field of Palestinian Telecom Forecasting, especially mobile communications.

The researcher hopes that this study will provide strong and reliable facts about the future of Palestinian telecom based on scientific and quantitative approach.

1.1.6 Research Methodology :

The approach in this research will follow an objective, statistically based method to estimate the market potential of cellular mobile users. More specifically, a time-series data will be used to examine the diffusion pattern by fitting it to a Multiple Regression Model.

Model Development: The shape of an innovation's diffusion pattern is based on an assumption of contagious information. The theory of information diffusion suggests an S-shaped curve for its path, also known as epidemic diffusion (Koski, 1998).

In the core of this study, a diffusion model will be developed based on a quantitative approach and historical time-series data using a multiple regression method. Nevertheless, a questionnaire be used to support the statistical model and help in answering some of the research objectives.

Most models use more than one independent variable to explain the behavior of the dependent variable. The linear model can be extended to include any number of independent variables.

The general linear regression model, with normal error terms, simply in terms of X variables

$$Y_t = \beta_0 + \beta_1 x_{t1} + \beta_2 x_{t2} + \cdots + \beta_p x_{tp} + \varepsilon_t \quad (1)$$

Where :

$\beta_0, \beta_1, \ldots \beta_p$ are parameters

Regression model (1) can be written as follows

$$Y_t = \beta_0 + \sum_{k=1}^{p} \beta_k x_{tk} + \varepsilon_t \qquad (2)$$

In equation (2) there are "p" independent variables, and β_0 is the Y intercept, so we have "$p+1$" parameters to be estimated.

The model building process will go for two scenarios. First model scenario will study the effect of the following variables on the diffusion of mobile users:

a) GDP per capita : which measures the economic situation ,

b) Fixed Lines: This is a measure of the number of fixed telephone lines.

c) Analog/Digital systems: It is three dimensional variable. Its value being Zero before introduction of GSM and One after it during transition period , and three at the absence of analog.

d) Competition: It is a dummy variable. Its value being Zero before competition and one after it.

Second model scenario will incorporate implicitly the variable of potential population by considering a dependent variable as a ratio between Mobile users and potential population.

Raw Data: The main data input for this research is a historical time series data of cumulative adoptions of Mobile Users in Palestinian territories (West Bank & Gaza), including Mobile Users belonging to Jawwal and other Israeli operators having subscribers in the area. Also Fixed Telephone subscribers' data will be collected and used. In addition to that, data related to GDP per capita will be gathered.

The annual data will be used as a unit of time, starting from the year 1994 till the end of 2006. i.e. 13 units of time will be used in the analysis.

Software Package Tool: Mainly SAS software package will be used in fitting and analyzing the data. In addition, SPSS package will be used where necessary.

1.1.7 Research Structure :

This thesis will be divided into six chapters as follows :

a) Chapter One, includes introduction and research variables, hypotheses, research problem, importance, objectives, previous studies and Telecommunications overview.

b) Chapter Two discusses the theory of forecasting and modeling. The focus will be on technological forecasting and innovation diffusion models.

c) Chapter Three discusses the Information and Communication Technology (ICT) diffusion factors in general and telecom diffusion in particular. In fact, mobile

diffusion can viewed as a subset of telecom diffusion, which in turn is a subset of ICT diffusion.

d) **Chapter Four** introduces research methodology, research procedures and data sources, research difficulties and limitations.

e) Chapter Five, covers the data analysis and discusses the results.

f) Chapter Six, concludes the research results and offers recommendations for further study and concerned bodies.

1.1.8 Scope and Limits

The mobile users intended in this research are those Palestinian subscribers belonging to Jawwal in addition to other Palestinian subscribers of competing Israeli operators covering Palestinian territories.

The study will focus on the total number of mobile users within the Palestinian market in the West Bank & Gaza.

The historical time-series data observations are limited to 13 annual data units starting from year 1994 till end of 2006. Fixed telephone lines, total mobile subscribers and GDP per capita on annual bases will be collected and analyzed.

As a result of data analysis and developed Regression models, data will be used to forecast the mobile subscribers in the Palestinian market for the next 10 years.

1.2 Previous Studies

The innovation diffusion literature has established that the spread of successful innovation over time typically follows a sigmoid or S-shaped curve (Frank, 2002).

Several behavioral theories have traditionally been set forth to explain the S-shaped nature of diffusion processes. For example, Griliches (1957) proposed an 'epidemic', demand-induced explanation for the emergence of an S-shaped diffusion curve; Mansfield (1961) sought to explain the observed patterns of diffusion in terms of the expected profitability of the innovation, and dissemination of information about its technical and economic characteristics.

The Logistic Model developed by Mansfield (1968) analyzes the interaction between purchasers and non-purchasers on innovation in a social system. It is also known as internal influence model as it considers the interaction between members within social system.

In the study of Boretos (2005), the author uses the assumption that the diffusion of mobile technology, as measured by the number of active mobile accounts, follows the well known S-curve of natural growth in competition systems. The accuracy of the logistic fit is tested against actual data for the whole world, Europe, China and the GSM system.
It concludes that active mobile account around the globe, are expected to grow from 1.7 billion in 2004 to approximately 2 billion in 2008, reaching a peak penetration of 29.2%.

Boretos (2005), states several reasons for the continuing growth of mobile accounts, although in a slower pace than that of recent years, such as the emergence of the 3G mobile technology, the use of multiple mobile accounts from the same person especially in the more developed countries, and of course the continuous growth of mobile penetration in later adopters such as china, India, and Latin America.

He notes important limiting growth factors such as the age of potential mobile user, low income, and extreme poverty that constitute considerable barriers for further growth in mobile use.

In the paper of Ilonen (2004) , he presents an automated framework for forecasting the diffusion of innovations. An information processing technique called a self-organizing map, SOM, is used to generate a map of the economic, technological and social market characteristics that have been found to affect diffusion. The framework is applied in the context of predicting the diffusion of cellular subscriptions and Internet use worldwide and separately, in the European Union.It yielded significantly better results than a regression using the Bass model.

The study of Ilonen (2004), have some limitations, such as forecasting accuracy may be limited by the choice of country characteristics, which is not necessarily generalizeable to all types of products and /or countries. Furthermore, the SOM application gives equal weight to all characteristics in defining similarity, while the effect on diffusion may actually vary between them, and parameters themselves may at least to some extent be product-specific.

In the study of Kim (2004)**,** the authors investigated the patterns of the technological diffusions of 17 Korean information and telecommunications (IT) innovations by applying various diffusion models. Bass model was chosen the most robust one. Differences of diffusion patterns between circuit-based and packet-based technology were examined by the external and internal influence as well as the critical mass point.

The study of Kim (2004) concludes that a higher speed of diffusion of packet-based innovations come from a greater imitation effect between potential adopters. In addition to that, the late take-off phenomenon no longer applies to packet-based innovations.

The study of **Karine** (2004)**,** investigates the effect of cellular tariffs and cellular phone prices on the market potential and the diffusion rate are evaluated.

In Karine's study, a modified logistic model is applied for estimating the impact of price on the diffusion. The results of his study indicate that cellular call tariffs and cellular phone prices are not significant predictors of diffusion of cellular subscriptions.

It is thus concluded that the logistic diffusion model might implicitly capture the somewhat constant price decline of cellular communications. The study analyzed only the digital cellular system in Finland. This sets, of course, limitations to the generalization of the results of this study to the diffusion of cellular communications in others countries, and to the diffusion of other services.

In the study of Jun et al, (2002), the authors applied a choice-based substitutive & competitive diffusion models to the Korean mobile telecommunication service market where digital service has completely replaced analog service.

In comparison with Bass-type models, these two models provide superior fitting and forecasting performance.

The authors developed a new choice-based diffusion model to describe an environment, such as the Korean mobile telecommunication service market, where substitution and competition occur simultaneously. The model also provides the flexibility to include marketing mix variables as in the regression analysis.

The study of Kshetri (2002) identifies and analyses the forces influencing the rapid mobile diffusion in China. The study indicates that major factors influencing the growth rate of mobile technology penetration in china include the influence of Marxist labor theory, post-Mao reform resulting in market openness and heavy

Foreign Direct Investment (FDI) inflow, rapid economic growth, reengineering of telecom sector leading to fierce competition, china's interest in World Trade organization (WTO) membership and development in mobile technologies.

Kshetri (2002), attempts to explain mobile diffusion in China by considering the unique forces influencing it as well as the forces influencing its supersets i.e. Telecom & ICT diffusion. The authors states some 'exportable' factors that influence rapid mobile diffusion in China include heavy investment in telecom sector, government initiatives and intense competition in, and reengineering of, the telecom sector.

Lastly, I could not found any published paper or academic research dedicated for Palestinian market, dealing with the topic of mobile diffusion forecasting & modeling. By reviewing the available above studies, the concern was to gather the most applicable factors which may have affected the mobile diffusion in general. It is found that GDP per capita, Fixed phone lines, Competition and Technology are widely used and incorporated in the study of mobile diffusion.
The approach of this research uses multiple regression technique to study the effect of the above factors on Palestinian mobile diffusion. The population growth factor and the mobile coverage area are also implicitly incorporated in the model development.

1.3 Telecom Overview in Palestine

Telecommunications and the Internet are among the most important sectors of the new world economy in general and Palestinian economy in particular.
Jawwal, which is the only cellular carrier in Palestine, employs over 700 people in the West Bank and Gaza Strip generating significant annual revenues. At the end of 2006, Jawwal had over 800,000 mobile subscribers.

Today's wireless services offered in the Palestinian market are mainly to transmit voice and brief text messages in addition to limited data services such as GPRS and MMS and cannot handle digital multimedia and other high-bandwidth Internet content. In contrast, the terminals of the advanced mobile services, provide high-speed mobile connections to the Internet and other communications networks, giving users full access to the rich content and commercial possibilities of the "information superhighway".

1.3.1 Jawwal Profile

Jawwal Company was established in 1999 as a project owned by the Palestinian telecommunications company PALTEL. After the completion of the first phase of the project, Jawwal was separated from the mother company PALTEL in December 2000 to be the first independent Palestinian cellular firm serving the Palestinian community in the Gaza strip and the West Bank. Jawwal license fees in the beginning were paid through PALTEL license. These fees were $30 million plus 7% of the company's total revenue that should be paid at the end of each financial year. An additional $4 million was paid to the Palestinian Authority for licensing Jawwal as an independent company[1].

[1] See PALTEL's financial reports for the years 1999, 2000.

The Palestinian Authority was not able to provide the licensing monopoly condition in the Palestinian market as it was unable to prevent the Israeli cellular companies from selling their services in the Palestinian market owing to political issues.

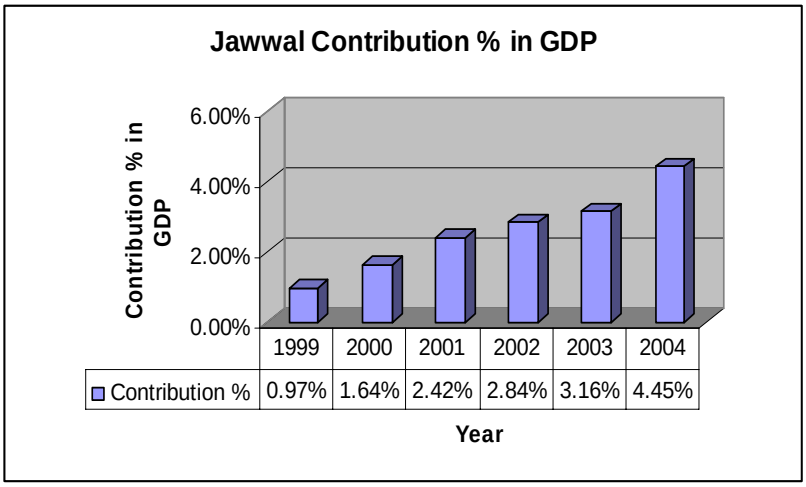
Currently, Jawwal is the main provider for mobile services in Palestine. Other illegal Israeli operators are still providing the service to Palestinian neighboring areas, but their market share is declining. Table 1.2 and Fig.1.4 below show Jawwal contribution to Palestinian economy till 2004.

Table (1.2): Jawwal Contribution to the Palestinian GDP.

	Year					
	1999	2000	2001	2002	2003	2004
Contribution in Millions (J.D)	34.18	48.4	67.8	75.5	94.9	127.5
Contribution %	0.97%	1.64%	2.42%	2.84%	3.16%	4.45%

Source: adjusted from Arab advisors (2004).

Figure (1.4): Jawwal Contribution to the Palestinian GDP.



Source: Adjusted by researcher.

1.3.2 The Competitive Situation

According to a strategic research conducted in July, 2004 by Arab Advisors Group, Palestine ranked at the top of the index having the highest score in Cellular Competition Intensity in the MENA region (Middle East and North Africa). The score is a bit deceiving, as there is only one licensed operator in the occupied territories. When counting the total number of working operators, however, one must take into account the competition from the four Israeli cellular operators covering the region without a license from the Palestinian Authority. Effectively, there are a total of five working operators in Palestine. By year-end 2003, Palestinian operator has a 40% share only (ArabAdvisors, 2004).

Recently, in March 2007, a new license were granted by the Palestinian National Authority for a Second operator to build and operate a GSM/3G network in the West Bank and Gaza. The amount to be paid for this license is about US$ 355 millions, which is a clear indication for an expected fierce competition in the Palestinian telecom market. The main obstacle for this new competitor to start work is the Israeli approval for the licensed frequency and shipment of equipment.

The current competitive landscape is summarized in Table 1.3 below. Although there are four unlicensed Israeli operators operating in Palestine, only Orange and Cellcom are significant. The Information below for Orange and Cellcom covers both their reported operations in Israel and in Palestine.

Table 1.3 Competitive comparison

	Jawwal	Orange	Cellcom
Owners	Palestine Cellular Telecommunications Company, 100% owned by Paltel since 2003	Hutchison Telecom (largest shareholder)	DIC Corporation: 94.5% share; other investors 5.5%
Grant of License	November 1996	April 1998	1993
Commercial Launch	15th August. 1999 in Gaza 2nd October. 1999 in WB	January.1999 GSM December 2004 launch of 3G	1994 Analog system 2002 GSM
Network Type	GSM 900 2x2.4 MHz (50% shared with Orange). (GPRS), No license for 3G Limited Spectrum	GSM 900, 1800, GPRS WCDMA,HSDPA 2x10 MHz .(Share 1x2.4MHz with Jawwal).	GSM 1800, TDMA, GPRS, EDGE 2004: UMTS, HSDPA
Subscribers	Subs: 437,000 (2004) 567,000 (Dec. 2005) 830,000(Dec.2006)	Subs:, 2.5 million (Q1 2006) 2G and 130,000 3G subs	Subs: 2.2 million
Market share	70% of Palestinian market	32% share of Israeli market	33% of Israeli market
Coverage (Jan. 2006)	93% of population 350 BTS 7 BSC, 3 MSC	97% of population (2G) 92% coverage on 3G 1550 macro, 714 micro, 30 BSC, 11 MSC 1280 3G macro,110 micro, 8 RNC, 1MSC	100% of Israeli population 360 marketing outlets, 30 service centers

Continued next page …

Continued : **Table 1.3** Competitive comparison

	Jawwal	Orange	Cellcom
Prepaid/Post-paid	Prepaid: 90%	Prepaid:30% 50% private, 20% business	N/A
ARPU	$18.0	US $32,	N/A
International partners:	Roaming partners: 236 operators in 112 countries	350 operators in 163 countries – 3G with 23 countries	N/A

Source: Adjusted by researcher from Arab Advisors reports (2002-2006) and Jawwal website www.jawwal.ps .

Chapter Two

Theory of Forecasting and Modeling

2.1 Introduction

Forecasting is an essential discipline in planning and running a business. Success depends, to a large extent, on getting those forecasts right. We know, however, that the future is highly uncertain. Throughout our lives we are confronted with uncertainties. There is, therefore, a fair chance that we will not make the right decisions.

In business we are continually confronted by the need to take decisions. The important decisions compel us to construct a route map of the future and to forecast which way our decisions will take us. A wrong decision can end in disaster. For that reason we need to bring a wide range of skills to bear on the possible and probable outcomes of the decisions.

2.2 Forecasting

Forecasting is a many-faceted topic. It can be on the other hand highly objective and mathematical science, but it can also be much a question of luck, if some analysis of how the things will develop in the future succeeds or not.

It should be born in mind that, despite all new computer techniques and the increased amount of activity and resources set on this area, forecasting will always be difficult - especially about the future.

The bigger, more complicated and abstract the object of forecast, the harder and more difficult becomes the succeeding in forecasting. But most of the forecasting is concerned about how sales or demand for certain items or raw material for the production will change. This information is vital to every business organization and for every significant management decision. Forecasting makes the basis of corporate long-run planning especially for finance, accounting and marketing as for productions and operations planning involving capacity planning, process selection and scheduling. But making perfect forecasts is usually impossible, because there are too many factors, which cannot be predicted with certainty. Therefore forecasts must be reviewed continually and you have to learn to live with inaccurate forecasts.

2.2.1 Eight Steps to Forecasting

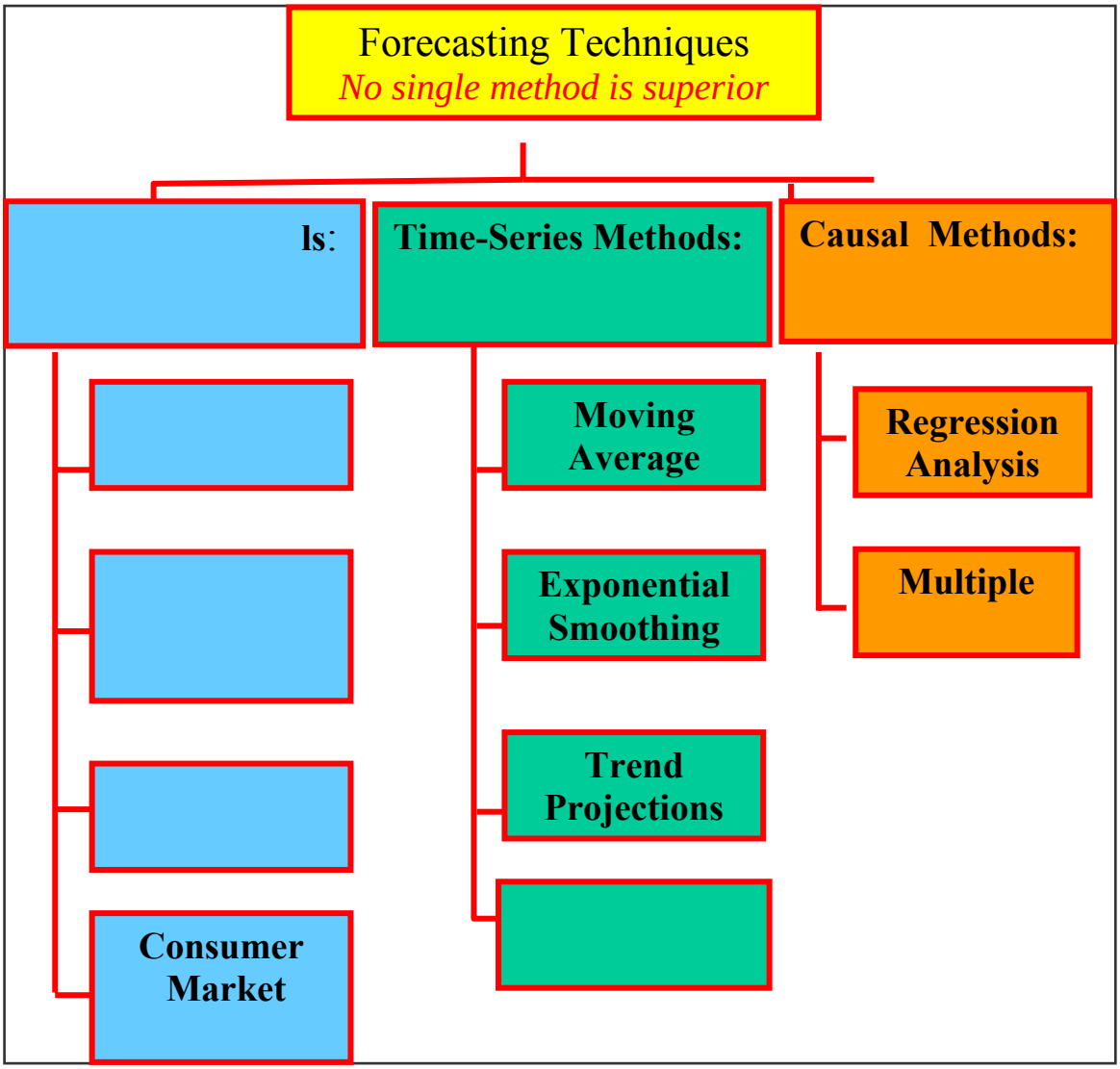
As described by Render et al.(2000) , following eight steps present a systematic way of initiating, designing and implementing a forecasting system :

- Determine the use of the forecast-what objective are we trying to obtain?
- Select the items or quantities that are to be forecasted.
- Determine the time horizon of the forecast – is it 1 to 30 days (short term), one month to one year (medium term), or more than one year (long term) ?
- Select the forecasting model or models.
- Gather the data needed to make the forecast.
- Validate the forecasting model.
- Make the forecast
- Implement the results.

2.3 Types of Forecasting

Forecasting can be classified into three basic types: *qualitative, time series analysis, and causal relationships.*

Figure (2.1): Forecasting Techniques



Source: (Render, 2000)

Qualitative techniques are subjective or judgmental and are based on estimates and opinions. The other two are almost completely based on the use of applying diverse mathematical models. Time series analysis is based on the idea that data relating to past demand can be used to predict future demand, which is then calculated by using various

statistical methods. Causal forecasting assumes that demand is related to some underlying factors in the environment, for example the number of permits for building of new houses in certain district and the sales of certain building materials in this area.

2.3.1 Qualitative Techniques in Forecasting

Qualitative models attempt to incorporate judgmental or subjective factors in forecasting model. They are used when there is no historical data as in the case of new product forecasting. Qualitative forecasting techniques are also used to predict changes in historical data patterns.

Grass roots forecasting builds the forecast by adding successively from the bottom, because of the assumption, that person closest to the customer or end use of the product knows the future needs best. Forecasts at this bottom level are summed and given to the next higher level and this procedure is repeated until it becomes input to the top level.

Market research is widely used especially for product research and for looking new product ideas. Data collection methods are primarily surveys and interviews, which are done by outside companies that are specialized this type of activities.

Historic analogies for existing similarly products can also be used as model for the forecasting of demand for a new product.

The idea of the ***Panel consensus*** is that a group of people from variety of positions can develop a more reliable forecast than narrower group. The forecast is developed through open meetings with free exchange of ideas from all levels of management and individuals. But difficulty of this method is that lower employees may not dare to refute different opinions of the higher levels of management.

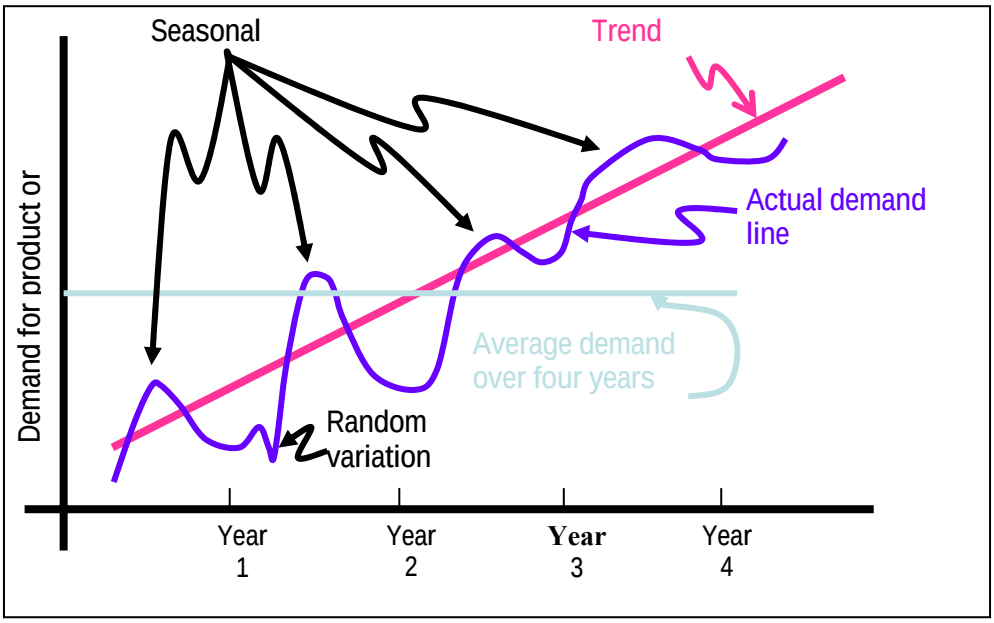
The ***Delphi technique*** is developed to correct this impairment. The identity of the individuals participating in the study is concealed. Everyone's answer has the same weight. A moderator creates a questionnaire and distributes it to participants. Their responses are summed and given back to the entire group along with the new questions. This is repeated if necessary and final results are distributed to all participants. Usually satisfactory results are achieved in three rounds.

2.3.2 Time Series Methods

Time series forecasting models try to predict the future based on past data. The sales of the last six weeks can be used to forecast sales for the seventh week and quarterly sales for the last several years can be used to forecast future quarters. *Short-term* analysis refers usually to less than three months, *medium-term* to three months to two years, and *longer-term* to greater than two years. In general, the short-term models compensate for random variation and adjust for short-term changes (such as a consumer's response to a new product). Medium-term forecasts are useful for seasonal effects, and long-term models detect general trends and are especially useful in identifying major turning points.

Time series data are often examined in hope of discovering a historical pattern that can be exploited in the preparation of a forecast. It is often convenient to think of a time series as consisting of several components: Trend, Cycle, Seasonal variations, and Irregular (random) fluctuations (Bowerman, 2005).

Figure (2.2) : Time series components , Trend , Random and Seasonality



Source: Adjusted by researcher.

There are number of methods available within time series, the most important among them are simple average, moving average, exponential smoothing, decomposition, and Box-Jenkins. Her it is assumed that the past data pattern will continue into the future. To prepare a forecast with this type of modeling, one needs only the historical data of a series one wishes to forecast (Jain, 2000).

2.3.3 Casual Forecasting Methods

In time-series methods, we saw that demand could be related to time. That is, the demand changed as time changed, while a relationship existed. We could not say for sure that time caused the changes in demand. There are factors other than time that are often related to demand and, in fact these factors often cause, or at least precede, the demand changes.

For example, increases in single-family housing starts during a given quarter might be highly related to the number of new marriages during the previous quarter. While marriages do not directly cause new houses to be purchased, it is logical to argue that marriages (which cause new households to form) are a major precondition to new housing starts. If there is a close relationship between two variables, they are thus said to be highly correlated. Correlation-based forecasts predict values based on historic patterns of covariation between variables. The relationship between housing starts in one quarter and marriages in a previous quarter is an example of a logical association. Many causally models use such "leading indicators" to predict upcoming events.

Jain (2000) refers to this type of relationship as cause-and-effect modeling, where there is a cause and there is an effect. He argues that although there are a number of models which fall in this type of modeling (regression, econometric, and input-output), the one which is most often used in business is regression.

2.3.3.1 Linear Regression

Linear (Least squares) regression is used to estimate a trend-predicting equation such as equations (2.1) and (2.2) below .The simple linear regression equation is:

$$Y'_x = a + bX + \varepsilon \quad \ldots \quad (2.1)$$

Y'_x = The dependent variable

a = The Y-axis intercept

b = The slope

X = The independent variable

ε = Error term

Multiple Regression : This linear regression methodology can be extended to situations in which more than one explanatory variable is used, called multiple regression, to explain the behavior of one dependent variable Y. . The multiple regression equation would be of the form:

$$Y'_{x1x2} = a + b_1X_1 + b_2X_2 + \varepsilon \quad \ldots\ldots \quad (2.2)$$

Y'_{x1x2} = The dependent variable based on the effect of two independent variables X_1 and X_2.

a = The Y-axis intercept

b_1 and b_2 = The slopes (rates of change in Y') with respect to X_1 and X_2

X_1 and X_2 = The independent variables .

ε = Error term

Whereas with simple linear regression we use a straight line to predict the dependent variable Y, with multiple regression with two independent (or explanatory) variables, the predicting equation represents a plane. And with three or more explanatory variables, the predicting equation is termed a hyper plane because it would be a plane in four – (or higher) dimensional space.

The solution of the sets of equations that determine the coefficients of the predicting equation is relatively straightforward, especially with the power of computers. However, the level of confidence of the forecast with additional independent variables drops off quickly. That is, one variable such as X_1 may help a lot in predicting Y; but adding another variable such as X_2 may only help a little bit more. This is termed the explained variance of Y; the first variable explains much of the variance but the second only explains a little more. And a third may add no further explanation.

2.3.3.2 Econometric models

In many cases, the dependent and independent variables used in forecasting models are interdependent. That is, sales may be a function of personal income and personal income a function of sales. Econometric models take these interrelationships into consideration by formulation, not one regression equation, but a series of simultaneous regression equations that relate the data to all of the interdependent factors, many of which are also predicted by the model (Chase, 1998).

2.3.3.3 Input-Output Models

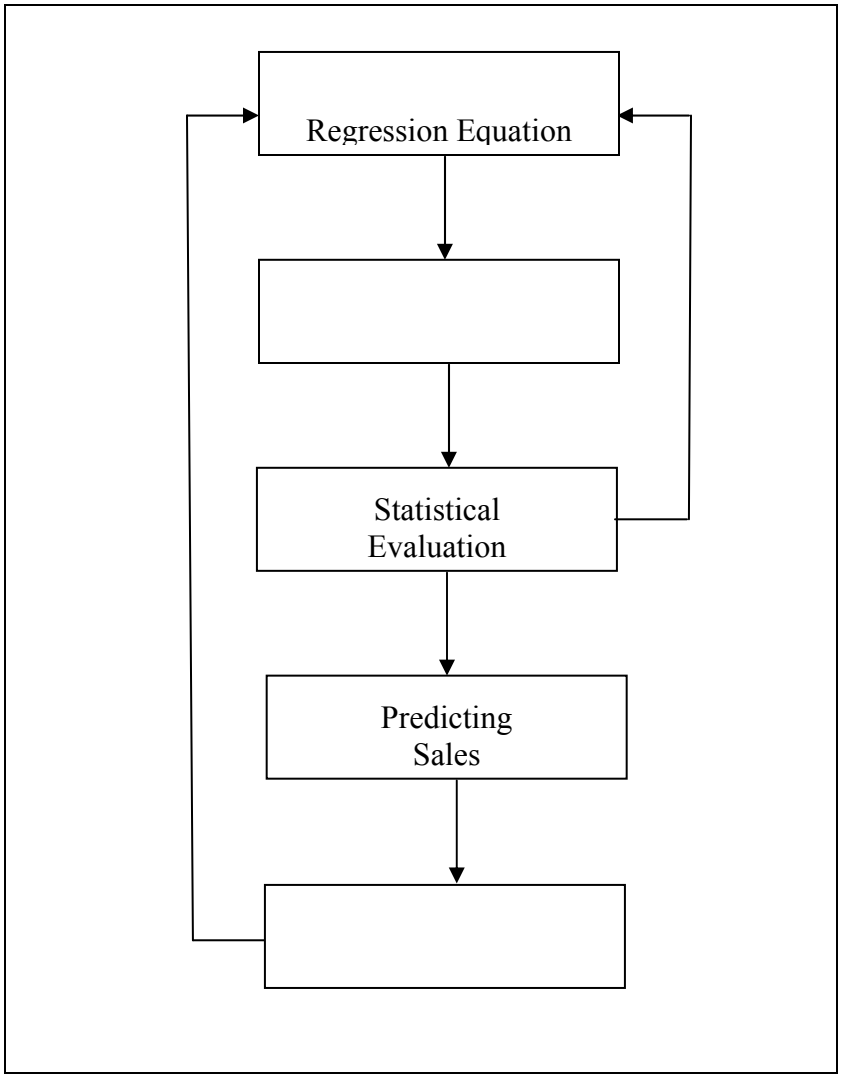
Here, inter-industry demands are analyzed to determine the net effect on each industry of all the other industries combined. A forecast of total demands on each and all of the industries is then computed in one overall solution. The model is particularly useful for determining expected changes in demands due to changes in other industries. However, the complexity of causal models and the corresponding time and data required for their construction are impediments to their use (Gaither, 2001).

2.4 Building a Regression Forecasting Model

The major steps involved in building and operating a forecasting model using the regression analysis approach are shown in the coming Figure 2.3. Following is an outline of these to build and operate a forecasting model using the regression analysis approach as stated by Hirst (2001):

I. The specification stage is concerned with selecting appropriate variables to include in the model, and specifying the relationships which link the variables together. If some of the significant independent variables are omitted from the equation, or if we assume the form of an independent variable to be linear when in fact it is related to sales in a non-linear fashion, we may seriously affect the accuracy of estimation and prediction.

Figure (2.3): Steps in building and operating a forecasting model using Regression



Source: (Hirst, 2001)

II. Even if the equation is properly specified, it still will not give the model a quantitative description without correctly estimated parameters. For example, once it is known that the equation has the form:

$$Y = a + bX + e \quad \ldots (2.3)$$

And the data for Y and X are available; values for the parameters (a) and (b) have to be estimated. As we mentioned earlier, this is usually done by the classic least squares method. Unfortunately, as we shall see later, the least squares method is only valid if certain assumptions are met. Many of these assumptions surround the nature of the disturbance term, u, and in practice they often break down. A great deal of the theory of econometrics is preoccupied with what, if anything can be done in this type of situation.

III. Statistical evaluation of the model follows the estimation stage. Two kinds of statistical criteria are normally applied. The first set is designed to test some of the assumptions that underlay the least squares procedure. The second type is that which measures the goodness of fit of the regression plane to the observed data. If the various statistical criteria are not met, the model builder must return to the specification stage and modify the equation. Use of a digital computer and one of the widely publicized stepwise regression programs makes this iteration process a relatively easy procedure. Great care is needed, however, to avoid the misuse of these labor-saving devices (Hirst, 2001).

IV. Once the model has been constructed, the model builder is in a position to use the model for prediction. In order to do this, values for the independent variables must first be determined, and this is frequently done by simple extrapolation using a naïve model. When these values have been obtained they are fed into the model and a forecast is derived for the dependent variable, sales. Some models predict the level of sales directly, while others are used to predict changes in sales.

V. Finally, the predictive ability of the model has to be evaluated. We can distinguish two types of predictive evaluation; a priori evaluation and ex post evaluation. It is the latter type of evaluation which is so often neglected, even though in many ways it is the most useful. One method of ex post evaluation is to compare the forecasts obtained with forecasts obtained from a less complex method of forecasting, such as a naïve model (Hirst, 2001).

It might be found that this comparison results in favor of the naïve method. This does not mean, however, that the naïve model should necessarily be used on a continuing basis. Rather, it points to the need for improved specification to develop an equation that will yield better results. Building and operating a forecasting model is not an ad hoc operation; the model has to be continuously monitored by the forecaster and updated as new information comes to hand.

2.5 Choosing a forecasting model

Since there is no one model which "fits in all" situations, one has to understand not only the characteristics of models and the data on hand but also the objective of a forecast so that the right model is selected. Here are the key elements one should be looking at:

2.5.1 Key elements for successful forecasting

Since there is no one model which “fits in all” situations, one has to understand not only the characteristics of models and the data on hand but also the objective of a forecast so that the right model is selected (Jain, 2000) .

Here are the key elements one should be looking at as stated by Jain (2000):

- Data pattern
- Amount of data available.
- Seasonality
- Strong and stable cause and effect relationship
- forecast horizon
- What and if analysis

Data Pattern: The component present (trend, cycle, seasonal or some combination of these) will help determine the model that will be used (Bowerman, 2005). One can easily see the pattern by plotting the data. If the data pattern is very smooth and consistent, time series modeling is the way to go. Matured products normally form a smooth and consistent pattern. Very often data have some spikes, but the question is whether or not they can be accounted for. The spikes may be the result of promotion, seasonality and or an outlier. Outlier is referred to an extreme value which may be unusually too high or too low. If spikes are caused by promotion or by any other variable(s) that drives it, then it has a cause and effect relationship. Then the best way to deal with this phenomenon is with regression modeling. If it is caused by seasonality, then it can be handled both with regression and time series modeling. If there is an outlier(s) in the data, it can also be handled both with regression and time series modeling. In regression, we handle this problem by using a dummy variable. But in time series modeling, the extreme value(s) has to be adjusted before a model is applied. If the value is too high, it has to be dampened; if it is too low, it has to be inflated. The objective, of course, is to bring the value to a normal level. There are procedures available for making such an adjustment, which is not within the scope of this study. But, if the adjusted data form a smooth and consistent pattern, we can apply time series models to generate a forecast.

Within regression modeling, we have both linear and curvilinear models. But most often, in business, linear regression models are used. But if the data form a distinct curvilinear pattern, one may have to look into a curvilinear model. Also, if the data form S curve, logit or probit regression may be the answer (Jain, 2000).

Amount of Data Available: Each model has a data requirement of its own. This is true both with time series and regression models. For example, in time series modeling, for 3-period moving average change method, one needs four periods of data, and for 4-period moving average change method, five periods of data. For the Box-Jenkins method, many experts believe one needs at least data of 40-50 periods for accuracy. For regression, one

needs at least data of five periods for each independent variable. If we have two independent variables, we need at least data of 10 periods (Jain, 2000).
If the needed historical data are not available, special data collection procedure may be necessary (Bowerman, 2005). So depending on the data, one knows which methods one can or cannot use.

Seasonality: Because of weather, custom or tradition, a given business does better in certain months and poorer in other months. This happens every year. This is called seasonality. For example, the best months for stationary sales are August and September because of schools' New Year. They experience this type of phenomenon year in and year out. If there is seasonality in the data, one has to find a model which accounts for it. If not, prepare a forecast and then adjust for seasonality by using seasonal indices. In time series models, the models that have a built-in feature for accounting for seasonality are decomposition, triple exponential smoothing and Box Jenkins. In regression, seasonality can be taken care of with dummy variables.

Strong and Stable Cause and Effect Relationship: As mentioned earlier, if there exist a strong and stable relationship between the sale (dependent variable) and the variable(s) that drives it, the regression models are the best candidates. But the relationship should not only be statistically valid but also theoretically sound. Sometime ago, some one found a strong relationship between the import of potato and the number of divorces in England. Here the relationship is statistically valid, but intuitively unsound – one has nothing to do with the other (Jain, 2000).

Forecast Horizon: Although a few scholars have attempted to categorize which method is more accurate in short, intermediate and long term forecasting, but there is no definitive proof for it. What we know is that, by and large, we can forecast better what will happen in the near future than far into the future, irrespective of the type of model used (Jain, 2000).

Also, some models cannot make a forecast beyond one period. For example, in time series modeling, models such as moving average, single exponential smoothing and decomposition cannot make a forecast beyond one period. In regression modeling, you need to know the values of independent variables of periods you wish to forecast. If you don't know the values of periods of far into the future, you cannot prepare their forecast either. There is some consensus that time series models are more appropriate for short-term forecasts. Though trend line model that belongs to time series family is often used for long term forecasting.

In general the length of time frame will influence the choice of the model. Typically, a longer time frame makes accurate forecasting more difficult, with qualitative forecasting techniques becoming more useful as the time frame lengthens (Bowerman, 2005).

What and if analysis: the choice of a model also depends on the objective of a forecaster. If the objective is to find out what drives the sale, which, at times, is the concern of upper management, then regression is the answer. Also, at times the objective may be to determine an optimal strategy. The forecaster may want to know what we have to do in way of pricing, advertisement and/or any other variable over which we have control so that we can hit the sale target. Here again regression modeling can provide the answer.

2.5.2 Some Reasons for Ineffective Forecasting

Some of the reasons for ineffective forecasting are found in Table 2.1 below .

Table (2.1): Some Reasons for Ineffective Forecasting

1.	Failure of the organization to involve a broad cross section of people in the forecasting system. Individual effort is important, but the need to involve everyone who has pertinent information and who will need to implement the forecast is also important.
2.	Failure to recognize that forecasting is integral to business planning.
3.	Failure to recognize that forecasts will always be wrong. Estimates of future demand are bound to be subject to error, and the magnitude of error tends to be greater for forecasts that cover longer spans of time. When operations managers have unrealistic expectations of forecasts, the fact that the forecasts were not on the nose is often used as an excuse for poor performance in operations.
4.	Failure to forecast the right things. Organizations may forecast the demand for raw materials that go into finished products. The demand for raw materials need not be forecast because these demands can be computed from the forecasts for the finished products. Forecasting too many things can overload the forecasting system and cause it to be too expensive and time-consuming. Things can overload the forecasting system and cause it to be too expensive and time-consuming.
5.	Failure to select an appropriate forecasting method.
6.	Failure to track the performance of the forecasting models so that the forecast accuracy can be improved. The forecasting models can be modified as needed to control the performance of the forecasts.

Source: (Gaither, 2001)

2.6 Conclusion

Developing a forecasting system is not easy. However, it must be done since forecasting is fundamental to any planning effort. In the short run, a forecast is needed to predict the requirements for materials, products, services, or other resources to respond to changes in demand.

Forecasts permit adjusting schedules and varying labour and materials. In the long run, forecasting is required as a basis for strategic changes, such as developing new markets, developing new products or services, and expanding or creating new facilities.

For long-term forecasts that lead to heavy financial commitments, great care should be taken to derive the forecast. Several approaches should be used. Causal methods such as regression analysis or multiple regression analysis are beneficial. These provide a basis for discussion. Economic factors, product trends, growth factors, and competition, as well as many other possible variables, need to be considered and the forecast needs to be adjusted to reflect the influence of each.

Short- and intermediate-term forecasting (such as required for inventory control as well as staffing and material scheduling) may be satisfied with simpler models, such as exponential smoothing with perhaps an adaptive feature or a seasonal index. In these applications, thousands of items are usually being forecast. The forecasting routine should therefore be simple and run quickly on a computer.

In summary, forecasting is tough. The ideal philosophy is to create the best forecast that you reasonably can and then hedge by maintaining flexibility in the system to account for the inevitable forecast error.

Chapter Three

ICT Diffusion

3.1 Introduction

The understanding of the forces influencing the diffusion of Information and Communications Technology (ICT) in general and telecom diffusion in particular would help to explain better the phenomena of mobile diffusion in a country. In fact, mobile diffusion can be viewed as a subset of telecom diffusion, which in turn is a subset of ICT diffusion. This chapter will explain the diffusion theory in general and review the global key indicators for ICT diffusion. Also, mobile telecommunication diffusion will be presented and reviewed over its key indicators.

Table (3. 1): Key Global Telecom Indicators

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Main telephone lines	546	572	604	643	689	738	792	846	905	983	1'053	1'086	1'140	1'207
Mob sub (m	16	23	34	56	91	145	215	318	490	740	955	1'166	1'414	1'758
Inte telephone traff (b	38	43	49	57	63	71	79	89	100	118	127	131	142	145
Personal computers (millions)	130	155	175	200	235	275	325	375	435	500	555	615	650	775
Internet users (millions)	4.4	7.0	10	21	40	74	117	183	277	399	502	619	724	863

Source : (ITU,2004) http://www.itu.int/ITU-D/ict/statistics/at_glance/KeyTelecom99.html

3.2 Diffusion Theory

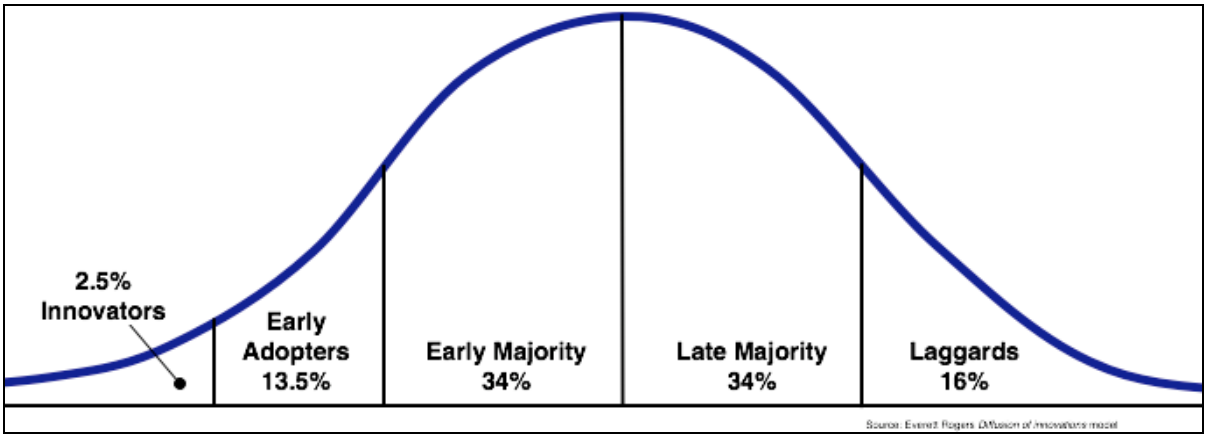
Adoption is the individual-level decision to use a new technology. Diffusion is the aggregation of a number of adoption decisions. Rogers (2003) defines it as "the process by which an innovation is communicated through certain channels over time among the members of a social system." Diffusion research is then concerned with finding patterns across a large number of adoption decisions.

The earliest economic models of diffusion were epidemic models. These models assumed that the diffusion of new technology is like that of an infectious disease. Non-adopters adopt a new technology when they come into contact with adopters and learn about the new technology. Over time, the number of users increases, leading to an increased probability of any given non-adopter learning about the technology (Rogers, 2003) . This increases the rate of diffusion. As more people adopt, the number of non-adopters declines, which decreases the rate of diffusion. This pattern of diffusion leads to the common S-shaped curve on the rate of technology diffusion with respect to time. See Figure 3.1 for technology adoption lifecycle.

3.2.1 Diffusion of Innovations

Diffusion of innovations theory was formalized by Rogers (2003) where it is called Diffusion of Innovations. Rogers stated that adopters of any new innovation or idea could be categorized as innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%), based on a bell curve as shown in Figures 3.1 and 3.2 below. Each adopter's willingness and ability to adopt an innovation would depend on their awareness, interest, evaluation, trial, and adoption. Some of the characteristics of each category of adopter include:

Figure (3.1): Technology adoption life cycle.



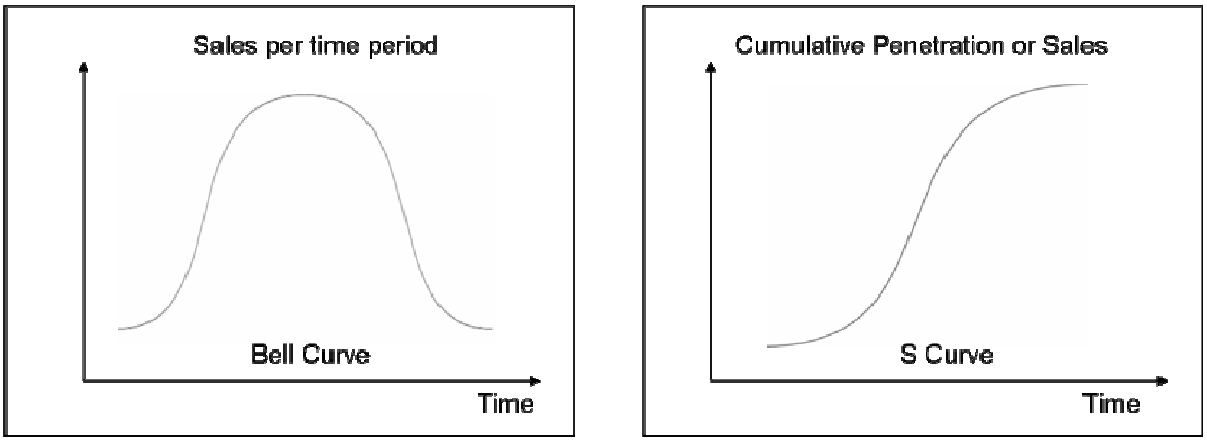
Source: (Rogers, 2003)

a) innovators - venturesome, educated, multiple info sources, greater propensity to take risk
b) early adopters - social leaders, popular, educated
c) early majority - deliberate, many informal social contacts
d) late majority - skeptical, traditional, lower socio-economic status
e) laggards - neighbors and friends are main info sources, fear of debt

Rogers also proposed a five stage model for the diffusion of innovation:

a) *Knowledge* - learning about the existence and function of the innovation
b) *Persuasion* - becoming convinced of the value of the innovation
c) *Decision* - committing to the adoption of the innovation
d) *Implementation* - putting it to use
e) *Confirmation* - the ultimate acceptance (or rejection) of the innovation

Figure (3.2) : The S-Curve and technology adoption



The adoption curve becomes a S-curve when cumulative adoption is used. Rogers theorized that innovations would spread through society in an S curve, as the early adopters select the technology first, followed by the majority, until a technology or innovation is common.

The speed of technology adoption is determined by two characteristics *p*, which is the speed at which adoption takes off, and *q*, the speed at which later growth occurs. A cheaper technology might have a higher *p*, for example, taking off more quickly, while a technology that has network effects (like a mobile or fax machine, where the value of the item increases as others get it) may have a higher *q*.

Rogers focuses on the role of communications networks in technology diffusion. He details the process through which innovations move from one population to another and discusses the role of five key factors in the individual decision to adopt relative advantage, complexity, compatibility, trial ability, and observability. He emphasizes that these factors are only relevant after informative contact with the innovation, and much of this work focuses on the roles of different communications networks in initiating this contact. This contact is achieved by a "change agent." The change agent brings an innovation into a new social network and can effectively communicate its benefits. Managers aiming to generate technology adoption should think of themselves as change agents.

Critics of this model have suggested that it is an overly simplified representation of a complex reality as argued by Danneels (2004) and David (2000). A number of other phenomena can influence innovation adoption rates, such as -

a) Customers often adapt technology to their own needs, so the innovation may actually change in nature from the early adopters to the majority of users.
b) Disruptive technologies may radically change the diffusion patterns for established technology by starting a different competing S-curve.
c) Lastly, path dependence may lock certain technologies in place, as in the old typewriter keyboard.

3.2.2 Stages of Diffusion Process

The process by which people accept new ideas is not a unit act, but rather a series of complex unit acts a mental process (Beal,1981) . This mental process consists of at least five stages. As Beal argues that evidence supports the belief that individuals can distinguish one stage from another and can designate points in time when they went through each stage. These stages are :

The awareness stage: At this stage an individual becomes aware of some new idea, such as telecom product. He knows about the existence of the idea, but he lacks details concerning it. For instance, he may know only the name and may not know what the idea or product is, what it will do or how it will work.

The interest stage: At the interest stage an individual wants more information about the idea or product. He wants to know what it is, how it works and what its potentialities are. He may say to himself that this might help him increase his income, or help him control time or effort, or improve job or home life in some other way.

The evaluation stage: The third stage in this mental process is the evaluation stage. The individual makes a mental trail of the idea. He applies the information obtained in the previous stages to his own situation. He asks himself, "can I do it; and if I do it, will it be

better than what I am doing now, will it increase my income, or will it help maximize any other values which I hold important"

The trial stage: If he decides that the idea has possibilities for him he will try it. The trial stage is characterized by small scale experimental use, and by the need for specific information which deals with: "How do I do it; how much do I use; when do I do it; how can I make it work best for me?"

The adoption stage: The final stage in this mental process is the adoption stage. This stage is characterized by large-scale, continued use of the idea, and most of all, by satisfaction with the idea. This does not mean that a person who has accepted an idea must use it constantly. It simply means that he has accepted the idea as good and that he intends to include it in his on-going program.

These, then, are the stages in the mental process of accepting new ideas and practices. Individuals may go through these stages at different rates, and any given individual may go through these stages at different rates depending upon the practice itself. The complexity of the practice seems to be a major factor in determining the rate and manner with which people go through these mental stages.

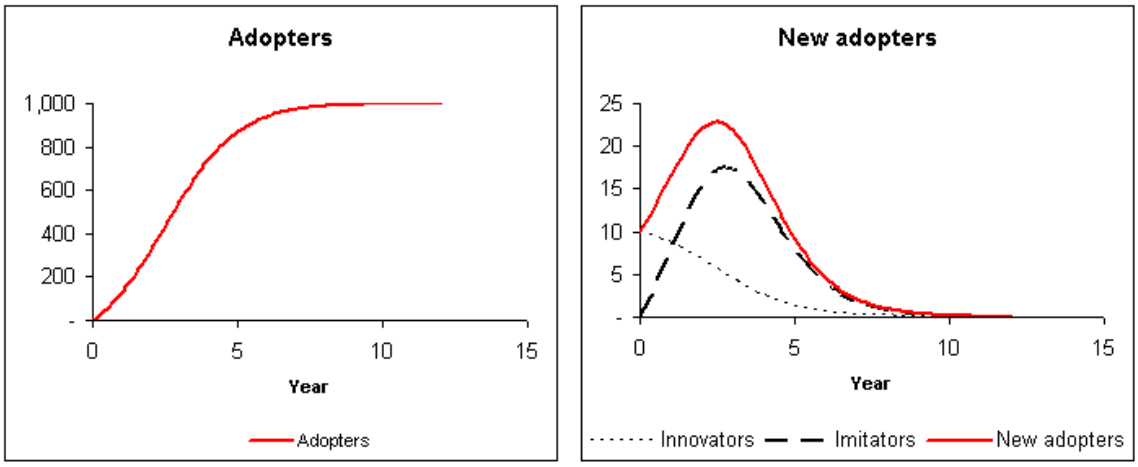
3.3 Diffusion Models

There are some famous and well known diffusion models usually used in technological and innovation diffusions researches. These are as follows:

3.3.1 Bass Diffusion Model

The Bass diffusion model was developed by Frank Bass (Bass, 1969) and describes the process how new products get adopted as an interaction between users and potential users. The model is widely used in forecasting, especially product forecasting and technology forecasting. Mathematically, the basic Bass diffusion is a Riccati equation with constant coefficients.

Figure (3.3): Bass Diffusion Model



Frank Bass published his paper "A new product growth for model consumer durables" in 1969. Prior to this, Everett Rogers published *Diffusion of Innovations*, a highly influential work that described the different stages of product adoption. Bass contributed some mathematical ideas to the concept.

3.3.2 Gompertz Diffusion Model

A Gompertz curve, named after Benjamin Gompertz, is a type of mathematical model for a time series, where growth is slowest at the start and end of a time period.

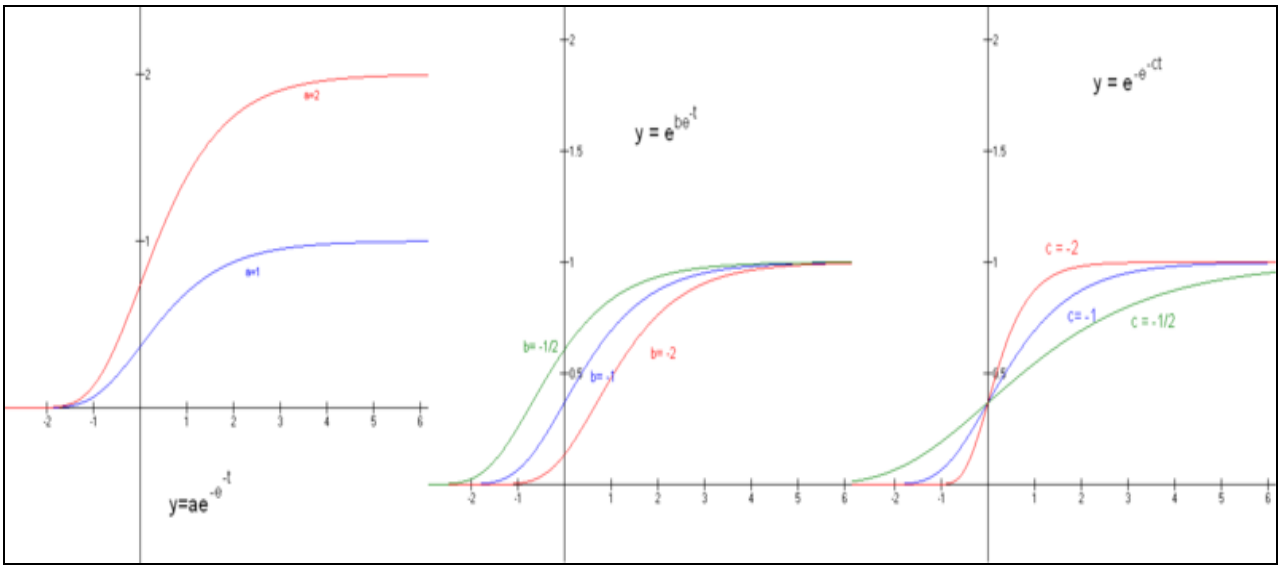
$$y(t) = ae^{be^{ct}}$$

Where:

- a is the upper asymptote
- c is the growth rate
- b, c are negative numbers
- e is the base of the natural logarithm (e = 2.71828...)

Following Figure 3.4 shows graphs of Gompertz curves, showing the effect of varying one of a,b,c while keeping the others constant.

Figure (3.4): Gompertz Diffusion Model



Source: http://upload.wikimedia.org/wikipedia/en/c/c5/Gompertz_com.PNG

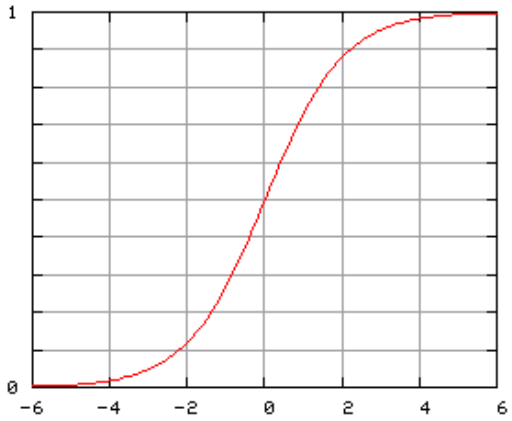
Examples of uses for Gompertz curves include:

a) Mobile phone uptake, where costs were initially high (so uptake was slow), followed by a period of rapid growth, followed by a slowing of uptake as saturation was reached.
b) Population in a confined space, as birth rates first increase and then slows as resource limits are reached.

3.3.3 Logistic Model

A logistic function or logistic curve models the S-curve of growth of some set *P*. The initial stage of growth is approximately exponential; then, as saturation begins, the growth slows, and at maturity, growth stops.

Figure (3.5): Logistic Diffusion Model



A typical application of the logistic equation is a common model of population growth, which states that:

a) the rate of reproduction is proportional to the existing population, all else being equal
b) the rate of reproduction is proportional to the amount of available resources, all else being equal. Thus the second term models the competition for available resources, which tends to limit the population growth.

A logistic function is defined by the mathematical formula:

$$P(t; a, m, n, \tau) = a\frac{1 + me^{-t/\tau}}{1 + ne^{-t/\tau}}$$

The special case of the logistic function with $a = 1$, $m = 0$, $n = 1$, $\tau = 1$, namely

$$P(t) = \frac{1}{1 + e^{-t}}$$

is called sigmoid function or sigmoid curve. The name is due to the sigmoid shape of its graph. This function is also called the standard logistic function and is often encountered in many technical domains, especially in artificial neural networks as a transfer function, probability, statistics, biomathematics, mathematical psychology and economics.

3.4 The Global Cellular Telecommunications Industry

In most countries, cellular phones were first available to end consumers in the 1980s. The technology initially used was based on analogue signal transmission, which was relatively inefficient and unreliable. In some countries, first-generation (1G) cellular networks reached their capacity relatively quickly, leading to lower service quality and congestion for initiating calls in particular. As soon as digital technology (second generation, 2G) had matured enough to present a credible alternative to analogue cellular, it was introduced gradually across the world (Dekimpe et al, 2000). Several different technological standards were in existence in different countries – for example, GSM in Europe, PDCS in Japan – and some countries – most notably the US – even introduced several standards in one country. Technological competition between standards within countries has been suggested to have slowed down overall diffusion, but may have had the long-term effect of fostering technological progress for future generations.

In addition to 2G's improved reliability and network capacity, 2G phones also had SMS functionality, which enabled users to send short text messages to each other and was a huge success among younger users, especially in Asia and Europe. Following the success of 2G, a third generation 3G with more advanced data transmission facilities was developed and is currently being rolled out.

Table (3.2): Global indicators for Mobile cellular subscribers diffusion

	Cellular mobile subscribers					**As % of total**
	(000s)		**CAGR (%)**	**Per 100 Inhabitants**	**% Digital**	**Telephone Subscribers**
	2001	**2006**	**2001-06**	**2006**	**2006**	**2006**
Africa	25'309.4	192'498.9	50.0	20.97	77.1	87.1
Americas	223'400.3	558'017.2	20.1	61.94	63.8	65.6
Asia	341'212.4	1'135'567.9	27.2	29.26	73.7	64.7
Europe	357'147.5	767'601.2	16.5	94.29	86.8	70.3
Oceania	13'701.2	24'066.2	11.9	72.55	93.1	66.6
World	**960'770.7**	**2'677'751.4**	**22.8**	**40.90**	**75.8**	**67.7**

Source: Adjusted by researcher from (ITU, 2006)

3.5 The Internet Technologies

The availability of Internet technologies to a non-scientific or military audience has introduced fundamental changes in current societies. The generalized acceptance of such services as the World Wide Web and e-mail is fostering the diffusion of Internet-related technologies both for commercial and social purposes .

The Internet sector has experienced a tremendous growth in the past decade, both in terms of the development of digital infrastructures and total number of Internet users. Nevertheless, the existence of significant national and regional differences in Internet adoption, owing to deficiencies in technological infrastructures, citizens' reluctance, or lack of needed skills to take advantage of Internet technologies, limits the potential benefits provided by new information services. A central concern in this regard is clarifying why Internet usage varies across countries and regions.

Table (3.3) : Global Indicators for Internet Diffusion

Internet					**Broadband Subscribers**	
	Subscribers (000s) 2006	**Subscribers per 100 inhab. 2006**	**Users (000s) 2006**	**Users per 100 inhab. 2006**	**Total (000s) 2006**	**Per100 Inhab. 2006**
Africa	10’735	1.28	43’568.7	4.76	1’098	0.12
Americas	99’612	11.40	332’942.3	37.02	80’349	8.93
Asia	184’596	4.80	1’241’495.8	32.19	104’853	2.71
Europe	123’996	15.16	290’576.4	35.73	89’732	11.02
Oceania	7’912	29.33	18’948.5	57.15	4’512	13.69
World	**426’851**	**6.67**	**1’927’531.7**	**29.57**	**280’544**	**4.30**

Source: Adjusted by researcher from (ITU, 2006)

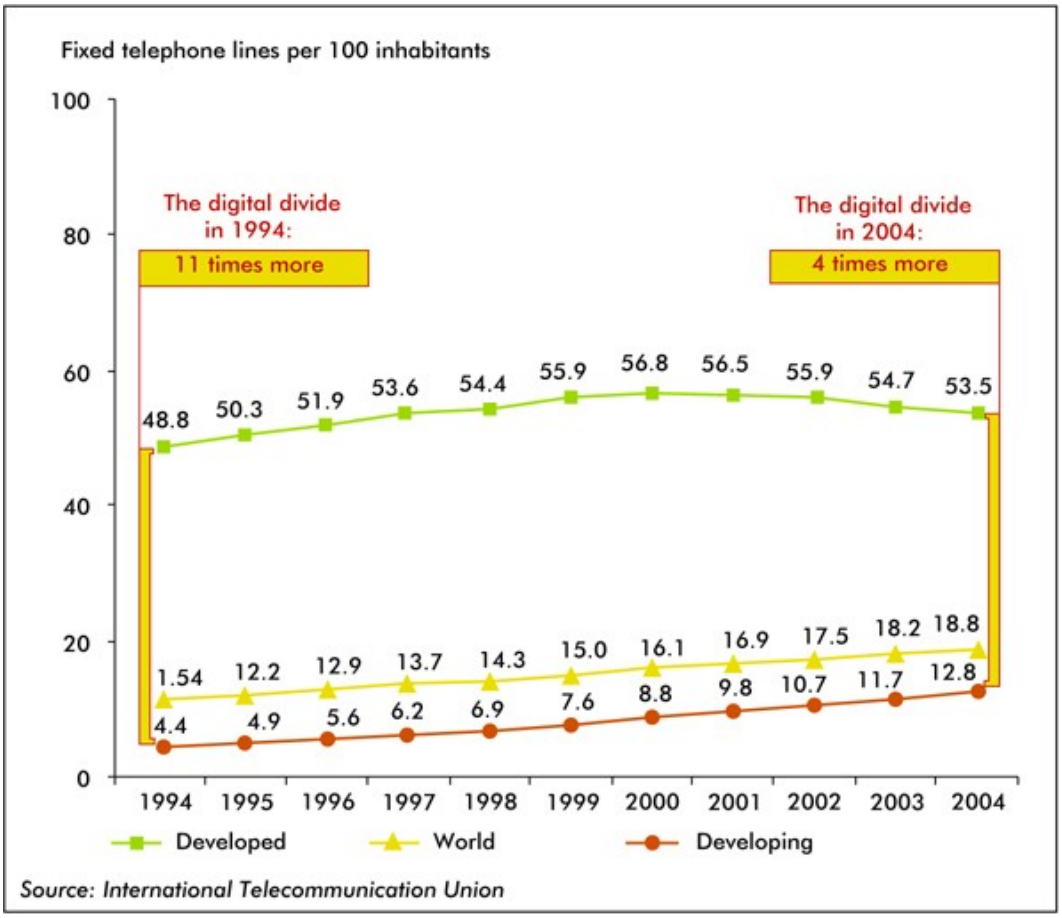
A deeper understanding of the adoption rates, purposes and characteristics of Internet users in different nations should also be beneficial in two main areas: companies operating in domestic and international markets should account for current differences in customers' acceptance and adoption of digital services; a detailed analysis of citizens' Internet usage patterns should help public authorities develop policies aimed at further developing digital infrastructures and promoting the use of Internet-related services

3.6 Global ICT Diffusion Trends

3.6.1 Fixed Phone lines

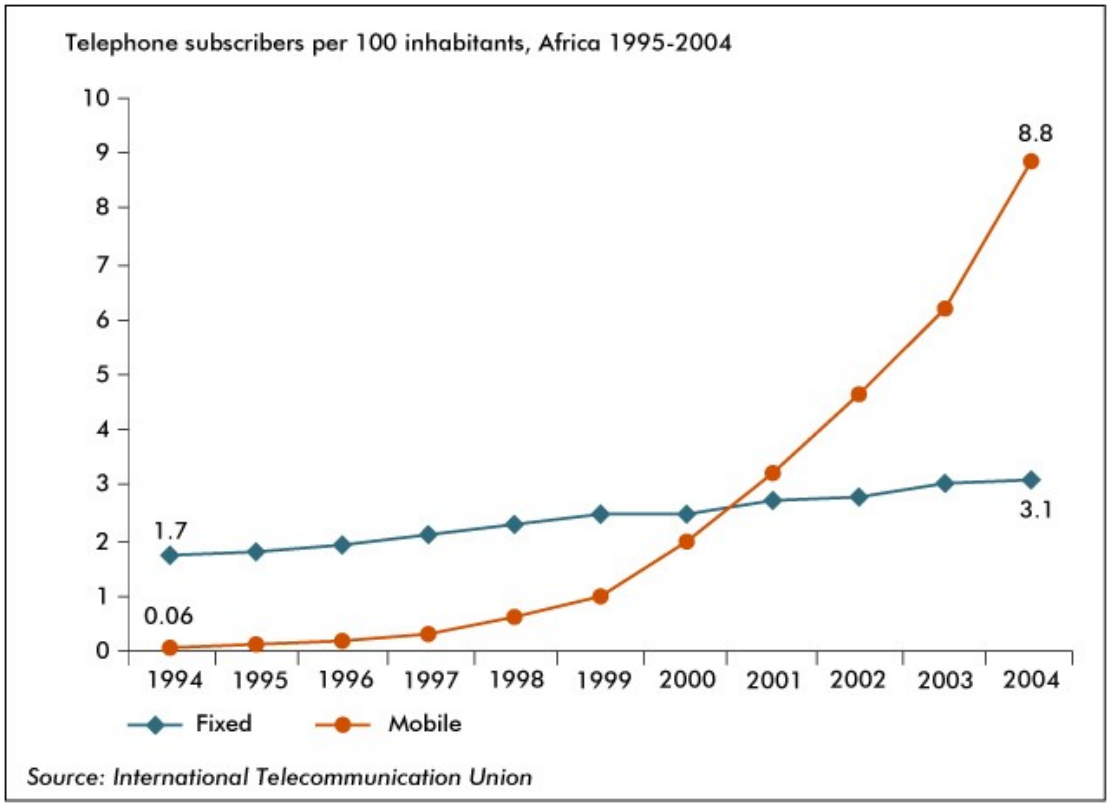
According to ITU statistics, the year 2002 marked an historic turning point in the history of telephony: the year when mobile subscribers overtook fixed-line subscribers worldwide

Figure (3.6): **Fixed -line** penetration comparison between developed & developing world



The Figure 3.6 above shows the fixed line penetration in developed countries compared with the fixed line penetration in Developing countries. The digital divide gap was decreased from 11 times in 1994 to 4 times more in 2004. Nevertheless the overall world penetration is growing up.

Figure (3.7): Fixed vs. Mobile uptake in Africa

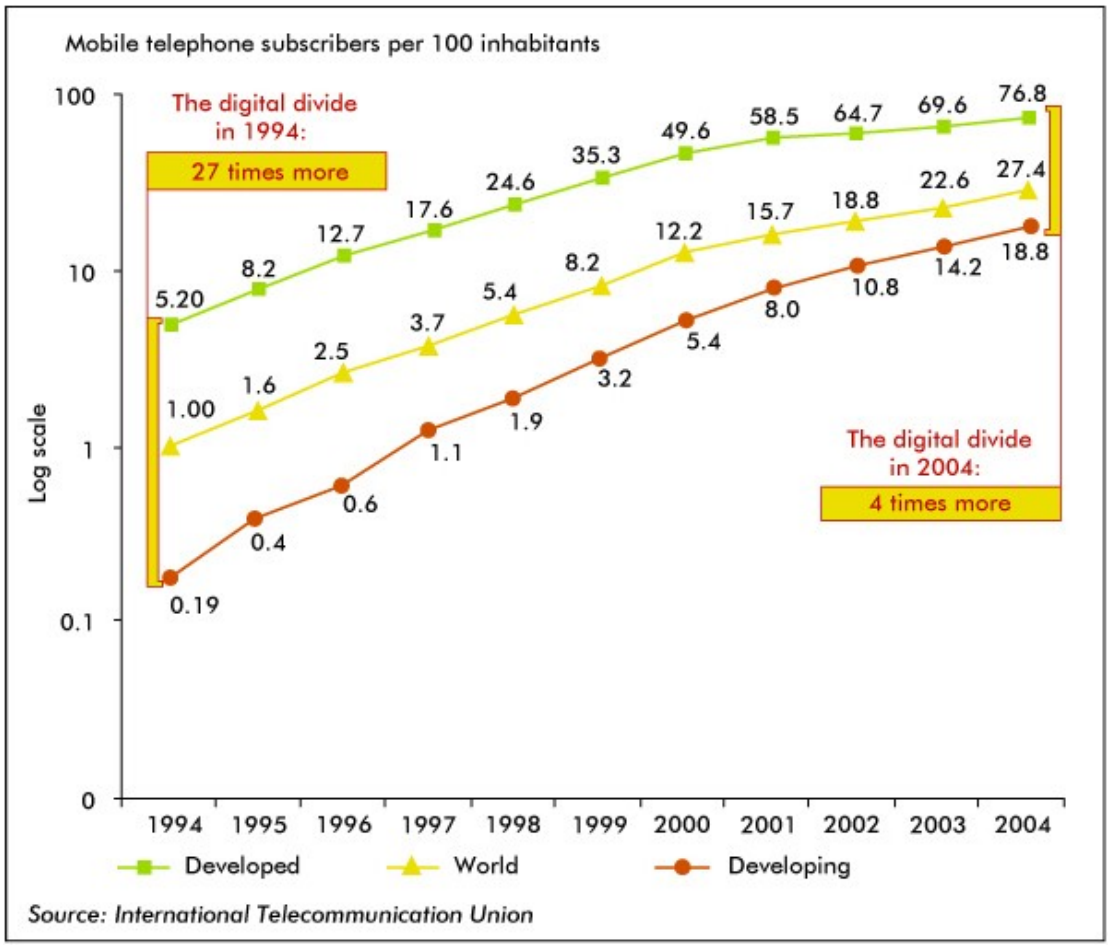


In the Figure 3.7 above, it is shown that the diffusion of Mobile subscribers overtook the slow diffusion of Fixed Telephone subscribers. The penetration of Mobile subscribers in Africa reached 8.8% by end of 2004 while it is only 3.1% for Fixed subscribers.

Although, the penetration of Mobile subscribers is higher and faster than Fixed subscribers, both are growing up.

3.6.2 Mobile Users

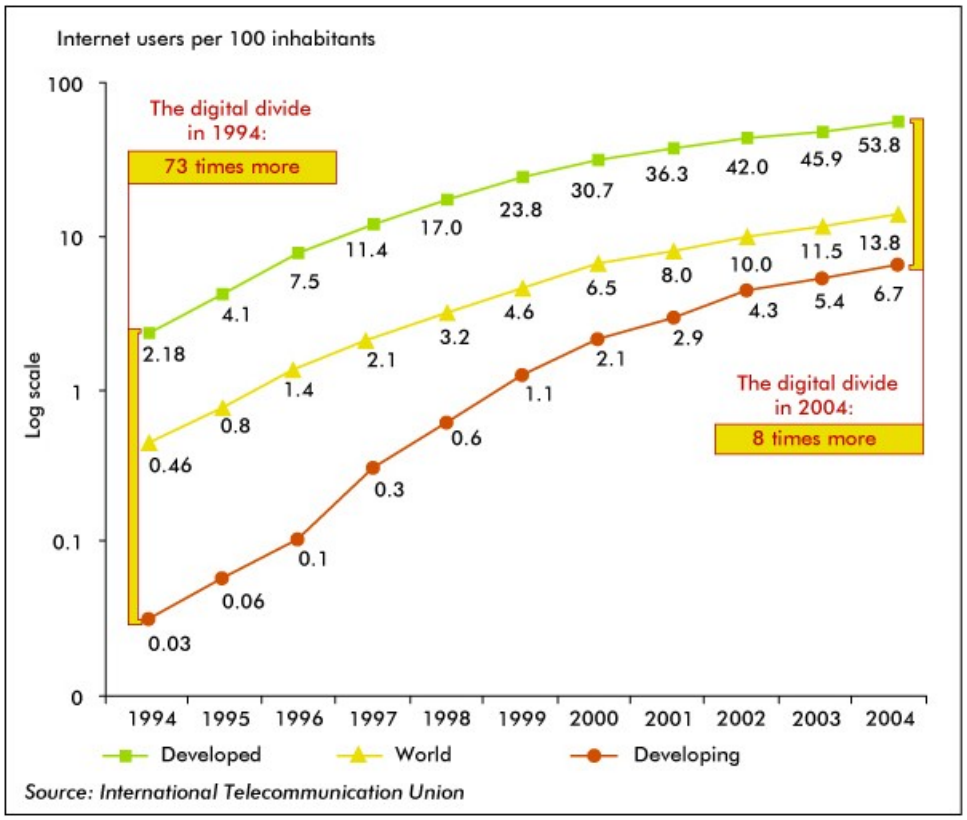
Figure (3.8): **Mobile** penetration comparison between developed & developing world



The Figure 3.8 above shows the Mobile telephone subscribers' penetration in developed countries compared with the Mobile telephone subscribers' penetration in Developing countries. The digital divide gap was decreased from 27 times more in 1994 to 4 times more in 2004. Nevertheless the overall world penetration is growing up .

3.6.3 Internet Users

Figure (3.9): **Internet** user penetration comparison between developed & developing world



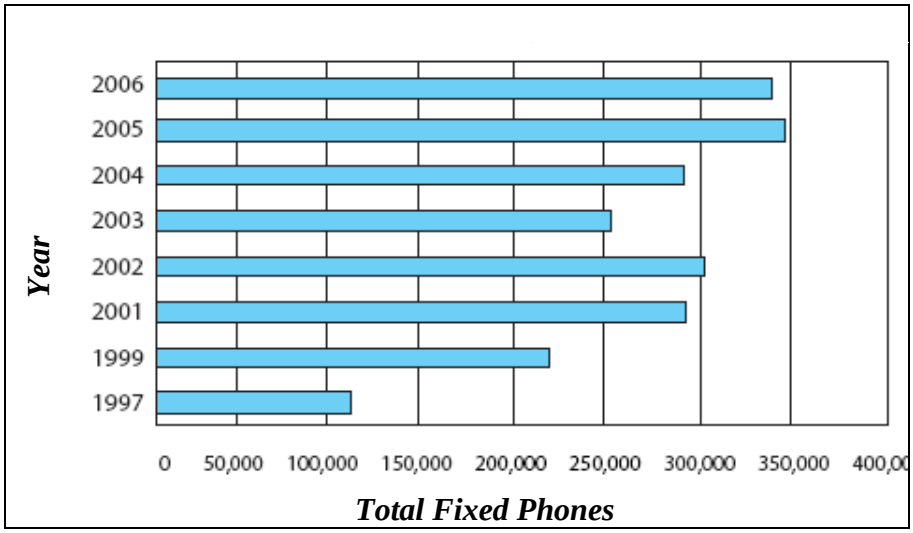
The Figure 3.9 above shows the Internet user penetration in developed countries compared with the Internet user penetration in Developing countries. The digital divide gap was decreased from 73 times more in 1994 to 8 times more in 2004. Nevertheless the overall world penetration is growing up with high rates .

3.7 Palestinian ICT Diffusion Trends

3.7.1 Fixed Phone Lines

The Fixed phone lines market started to experiences a rapid growth since the privatization of telecom market in 1997. The penetration rate doubled in the first two years from 4% in December, 1997 to 8% by end of 1999. By end of 2006, the total number of Fixed phone lines hit the 341,330 figure, with penetration rate of 9% (Paltel, 2006) .

Figure (3.10): Fixed Phone lines in Palestinian Market

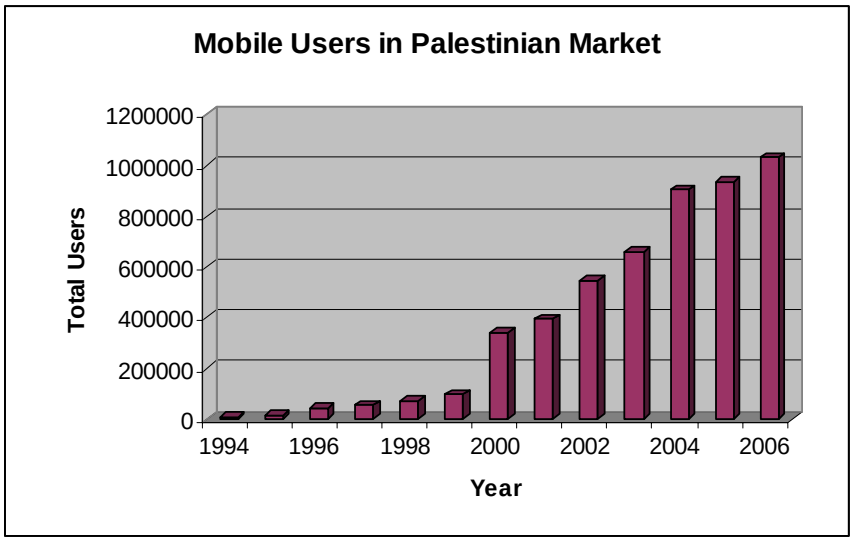


Source: (Paltel, 2006)

3.7.2 Mobile Users

The mobile users started rapid diffusion at year 1999 after the lunch of the first national Palestinian provider (Jawwal) for Mobile Telecommunications using new digital GSM system. Prior to that year, Palestinians was dependent on Israeli Mobile operators who have a plausible coverage in Palestinian areas. By end of 2006, the total mobile users in Palestinian market hit the 1.031 million figure, with penetration rate around 25%. According to Paltel (2006), Jawwal market share exceeded 70% by end of 2006.

Figure (3.11): Growth of Mobile Users in Palestinian Market

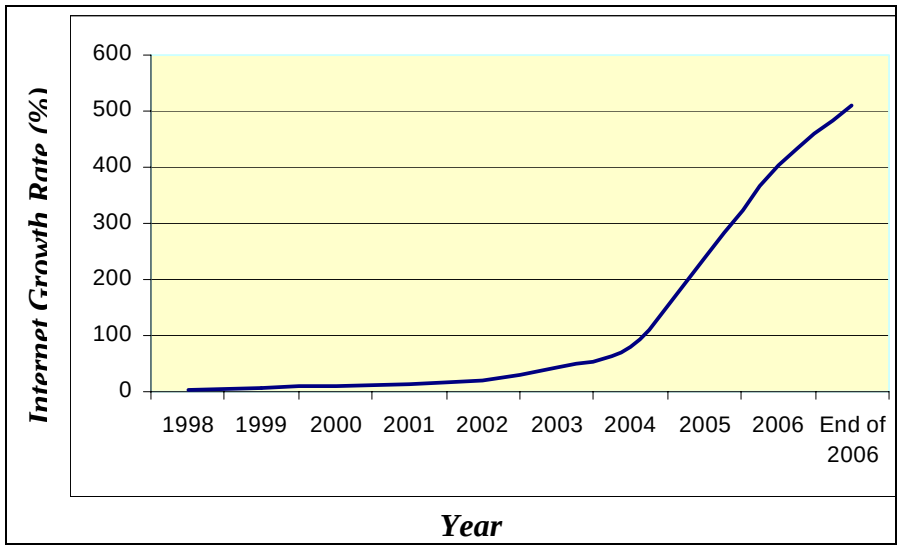


Source : Adjusted from Appendix (C)

3.7.3 Internet Users

Paltel introduced the project of Subscription Free Internet (SFI) service for its Fixed phone line subscribers in the year 2004. This step double the Internet users by 100% in that year. In addition to this basic Internet service, Paltel introduced the ADSL service by 2005 with different high speeds. (Paltel, 2006). According to Paltel (2006), the ADSL subscribers exceeded 12% of Fixed phone subscribers base and growing rapidly in the last two years.

Figure (3.12) : Growth Rate of Internet Users in Palestinian Market



Source : (Paltel, 2006)

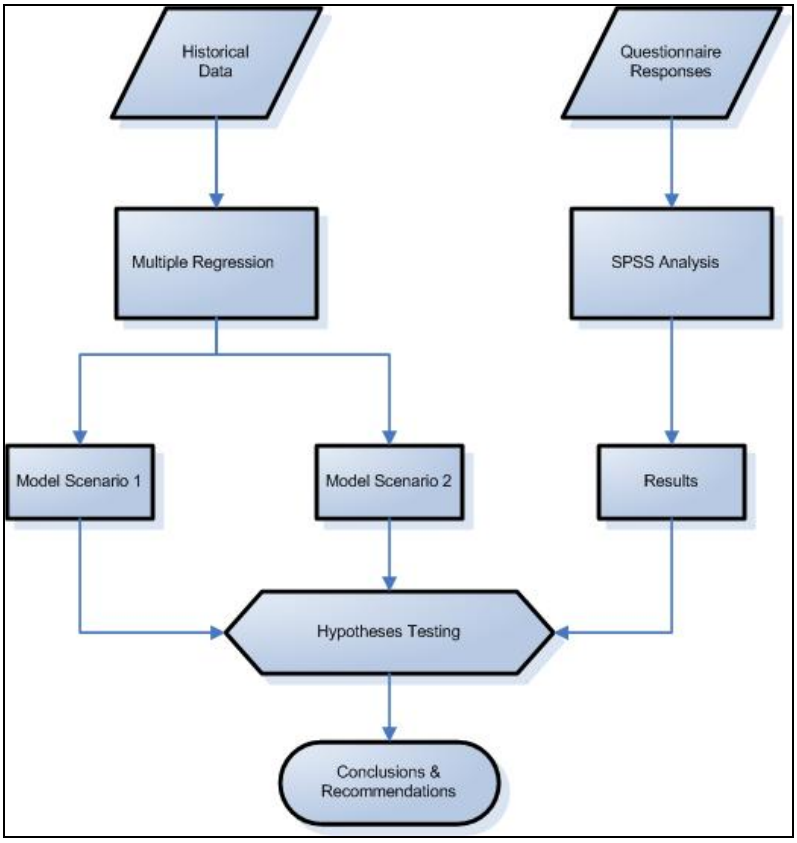
Chapter Four

Research Methodology

4.1 Introduction

This chapter describes the methodology used to achieve the goal and objectives of the research. The main approach of this research follows an objective, statistically based method to estimate the future of mobile users in the Palestinian market. Nevertheless, a questionnaire was used to enhance the statistical model that helps in answering some of the research objectives. Figure 4.1 summarizes the research methodology.

Figure (4.1) : Research Methodology Flowchart



4.2 Model Data

The main data input used to build and operate the diffusion model was a historical time series data of cumulative adoptions of mobile users in the Palestinian territories in the West Bank and the Gaza strip . Those mobile users belong to Jawwal and other Israeli operators having subscribers in the Palestinian market.

The model consists of four independent variables which have been chosen carefully and expected to have influence on the diffusion pattern of mobile users. Those variables are :

a) GDP per capita: This variable is used to measure the economic situation in the Palestinian territories.

b) Fixed Phone Lines: This is a measure of the number of fixed telephone lines working in the Palestinian market in the West Bank and the Gaza strip .

c) Analog/Digital systems: It is a three dimensional variable. Its value being Zero before introduction of GSM and One during the transition period , while it is three at the absence of Analog systems. This variable is useful to measure the effect of digitalization on the diffusion process and mobile users' growth.

d) Competition: It is a dummy variable. Its value being Zero before competition and one after it. This variable is expected to be significant since all the marketing theories consider the competition effect in accelerating the growth rate of mobile diffusion.

Starting from 1994 till the end of 2006, the annual data was used as a unit of time, i.e. 13 units of time were used in data analysis. Consequently, corresponding annual data for each variable was collected and tabled in a time series for the past 13 years.

4.2.1 Sources and Collection of Historical Data

There was a clear difficulty to find a historical data on regular periods of time for most the variables due to different reasons. The most difficulty was in getting the number of mobile users especially for those belong to the Israeli operators having subscribers in the Palestinian market. Nevertheless, the researcher successfully collected the required data adjusted from variety of resources including official bodies such as the Palestinian Central Bureau of Statistics (PCBS) and the Ministry of Telecommunications and Information Technology (MTIT).

There were two major difficulties in collecting continuous time series data. The first is the missing figure for one or several intervals of time. The second is multiple data for the same period of time which reflects the need for unified and reliable source of national data. Nevertheless, the researcher was able to overcome these difficulties since he is working in the telecom field for the last nine years which give him a strong background of recognizing and interpreting such data. Table 4.1 below, contains the main input data required to develop the model. It is reported on annual bases for the past 13 years, i.e. from 1994 till the end of 2006.

Table (4.1): Historical Time series data

Obs.	Year	CEL	FIX	GDP (US$)	DIG	CMP
1	**1994**	6000	58459	1126	0	No
2	**1995**	15000	59850	1234	0	No
3	**1996**	41000	61241	1241	0	No
4	**1997**	53000	110893	1313	0	No
5	**1998**	71000	167271	1346	0	No
6	**1999**	96538	222198	1374	1	No
7	**2000**	341000	272212	1307	1	Yes
8	**2001**	393791	292022	1171	1	Yes
9	**2002**	544997	301579	1035	1	Yes
10	**2003**	659418	252038	1128	2	Yes
11	**2004**	903405	290010	1134	2	Yes
12	**2005**	936292	348968	1129	2	Yes
13	**2006**	1030705	341330	1141	2	Yes

Source: Appendix (C)

1. **CEL :** Total number of cellular mobile users in the Palestinian Market . This includes

subscribers belonging to Jawwal in addition to other Palestinian subscribers of competing Israeli operators serving in the Palestinian market.

2. **FIX** : Total number of Fixed telephone lines working in the Palestinian Market. This belongs to Paltel subscribers.

3. **GDP** : The Gross Domestic Product (GDP) per Capita in US dollars.

4. **DIG** : Indication of network type availability . Zero for the Absence of Digital and One for the Presence of Both Digital and Analog, and Two for the Digital presence Only.

5. **CMP** : An indicator for Competition in the Palestinian Cellular Market. 'Yes' means that competition exists and 'No' for the absence of competition.

4.2.2 Multiple Regression Model

A major problem in regression analysis is that of deciding which independent variables should be in the model. Suppose that $x_1, x_2, ..., x_k$ is the complete set of all possible independent variables including any functions such as squares, cross-products, etc., which may seen appropriate. Then there are two conflicting criteria for selecting a subset of independent variables:

a) First, the model chosen should include as many of the $x's$ as possible if reliable predictions are to be obtained from the fitted equation.
b) Second, because of the costs involved in obtaining information on a large number of independent variables, we would like the equation to include as few $x's$ as possible; also the variance of the independent increases with the number of independents (Kutner et.al.,2004).

A suitable compromise between these two extremes is usually called "selecting the best subset" or "selecting the best regression equation." However, the term "best" is subjective; there is no unique statistical procedure for choosing the subset and personal judgment is needed in all the statistical methods. For instance, if two independent variables are highly correlated with Y and highly correlated with each other, then it is often sufficient to include just one of the independents in the regression; once one independent is in, the additional contribution of the other is frequently negligible.

The choice of which independent to include may depend, for example, on which variable is easier or cheaper to measure. If we assume, for ease of exposition, that Y-intercept is always included in the model (though this is not necessary), an obvious approach to this "best subset" problem is to fit every possible regression equation that can be obtained by selecting 0,1,2,…,k of the independents $x_1, x_2, ..., x_k$; since there are two possibilities for each independent, "in" or "out" of the equation, there are 2^k such regressions. For k large (e.g., $2^{12} = 4096$), we are faced with comparing a large number of equations so that we need, first, an efficient algorithm for generating all the possibilities and, second, a readily computed measure for comparing the predictive, usefulness of the different models.

In our model building process we will consider the historical time-series data of cumulative mobile users (dependent variable, Y) in Palestinian market since 1994 till end of 2006 on annual bases. The interest is to study the relationship between the cumulative mobile users (Y) and a subset of the following variables:

X_1 GDP per capita

X_2 Fixed Phone Lines

X_3 Analog/Digital systems

X_4 Competition

The goal of this process is to construct a regression model with the best subset of the independent variables. This model should be as simple as possible with high predictive abilities.

There are several reasons to reduce the number of independent variables to be used in the final regression model:

1. Regression models with numerous independent variables may be difficult to maintain.

2. Regression models with a limited number of independent variables are easier to work with and understand.

3. The presence of many highly inter-correlated independent variables may substantially increase the sampling variation of the regression model. This may detract from the model's descriptive abilities, increase the problem of round off errors, and may even worsen the model's predictive ability (Kutner et.al.,2004).

In particular, Competition score (X_4) is expected to have high correlation with (Y). Since Competition is a key factor in pricing and promotion strategies. As a result, it is expected that the Competition score variable (X_4) is the most significant variable in predicting (Y).

4.2.3 Model Building Process

Most models use more than one independent variable to explain the behavior of the dependent variable. The linear model can be extended to include any number of independent variables. The general linear regression model, with normal error terms, simply in terms of X variables

$$Y_t = \beta_0 + \beta_1 x_{t1} + \beta_2 x_{t2} + \cdots + \beta_p x_{tp} + \varepsilon_t \quad (4.1)$$

Where

$\beta_0, \beta_1, \ldots \beta_p$ are parameters

Regression model (4.1) can be written as follows

$$Y_t = \beta_0 + \sum_{k=1}^{p} \beta_k x_{tk} + \varepsilon_t \qquad (4.2)$$

In equation (4.2) there are "p" independent variables, and β_0 is the Y intercept, so we have "$p+1$" parameters to be estimated.

In our model we will have following:

Y_t : [CEL] , Mobile users at time t.

t : Observation at time t (Years 1994 – 2006)

p : 4 independent variables.

β_0 : Y-Intercept.

Xt_1 : [GDP] , GDP per capita at time t.

Xt_2 : [FIX] , Fixed Phone Lines at time t.

Xt3 : [DIG] , Analog/Digital systems at time t.

Xt4 : [CMP] , Competition at time t.

ε_t : Error term at time t.

For "DIG" variable, it has 3 values as follows :

0 → Not Digital. It means Analog only .

1 → Mix of both technologies (Digital and Analog)

2 → Digital only.

In multiple regression, we use binary variable for "DIG". Hence we demonstrate the "DIG" variable as follows:

Table (4.2): Binary variable demonstration for "DIG"

Variable	***Value***	***Description***
DIG_0	1	Not digital
	0	Mix (Digital+Analog)
	0	Digital only
DIG_1	0	Not digital
	1	Mix
	0	Digital only
DIG_2	0	Not digital
	0	Mix
	1	Digital only

We use "DIG_2" as a base group, so the variables "DIG_0" and "DIG_1" are included in the regression model, in addition to other remaining variables, "GDP", "FIX" and "CMP". Hence, the multiple regression equation will have the following form :

$$CEL\_predicted = b_0 + b_1.GDP + b_2.FIX + b_3.CMP + b_4.DIG\_0 + b_5.DIG\_1 \quad \ldots(4.3)$$

4.3 Questionnaire Review

The questionnaire was designed as a supportive tool to enhance the model results and to provide a general view about the population opinion and their interests toward cellular mobile services and related issues.

It was constructed to fit in one page with total of 28 questions to encourage the respondents and to avoid random and unrealistic answers. The questionnaire consists of four main fields as described in Table 4.3.

Table (4.3): Distribution of questions to fields and their weights

Field	***No. of Questions***	***Weight %***
Personal characteristics of respondents	14	50%
Factors to acquire mobile line	5	18%
Importance of services needed from using Mobile	4	14%
Factors affecting respondent's decision in choosing or transferring to other cellular provider	5	18%
Total	**28**	**100%**

4.3.1 Population and sample size

The population consists of all the Palestinian citizens living in the West Bank and the Gaza Strip (WBG). According to the Palestinian Central Bureau of Statistics (PCBS, 2007) , the Palestinian population in WBG reaches 4,016,416 citizens. About 62.7% are living in the West Bank and 37.3% in the Gaza Strip. For 5% Error level, minimum 400 sample size will be needed to represent this population. See appendix (J) for sample calculations.

We choose Stratified Random sample. The Questioners distributed over geographical locations of 16 Governorate in WBG with respect to the number of people living in each. Table 4.4 below summarizes the sample size required and collected with relation to the two main geographical areas, i.e. The West Bank and the Gaza Strip.

Table (4.4): Sample size and response rate distribution

Location	Total Population	Population > 18 years	% of Population 18 +	Minimum Required	Collected Responses
West Bank	2,517,047	1,269,361	65.16%	260	261
Gaza Strip	1,499,369	678,645	34.84%	139	379*
Total	4,016,416**	1,948,006**	100%	400	640

* Collected is high in Gaza due to easy distribution & delivery.

** Source: Palestinian Central Bureau of Statistics (PCBS, 2007).

4.3.2 Questionnaire Reliability

The reliability of an instrument is the degree of consistency which measures the attribute; it's supposed to be measuring. The less variation an instrument produces in repeated measurements of an attribute, the higher its reliability. Reliability can be equated with the stability, consistency, or dependability of a measuring tool. Cronbach's Coefficient Alpha is used as a test of reliability.

4.3.2.1 Arbitrating the Questionnaire

This was accomplished by distributing the questionnaire to a group of five arbitrators containing two academic members from the Islamic University of Gaza/ Faculty of Commerce, and three seniors in the field of Telecommunication services.

Comments were sought from these arbitrators on different aspects of the questionnaire, and few adjustments were made to it according to these collected comments and finally to be sure that the collected data was able to accomplish the objectives of the research.

4.3.2.2 Pilot Study

These structured questionnaires should be based on a carefully prepared set of questions piloted and refined until the researcher is convinced of their validity. Therefore the pre-testing is an important stage in the questionnaire design process, prior to finalizing the questionnaire. It involves administrating the questionnaire to a limited number of potential respondents and other knowledgeable individuals in order to identify and correct design flaws

The Arabic version of the questionnaire was tested in order to make sure that the questions were easily understood .The test was made by distributing 50 drafts. As a result of this test, it was shown that respondents had no difficulty in understanding the questions and consequently answering them carefully. Reliability test in the next paragraph proves this result.

4.3.2.3 Reliability Statistics

Cronbach's Coefficient Alpha method is used to measure the reliability of the questionnaire between each field and the mean of the whole fields of the questionnaire. The normal range of Cronbach's coefficient alpha value between 0.0 and +1.0, and the higher values reflects a higher degree of internal consistency.

Table (4.5): Cronbach's Alpha for each filed of the questionnaire and the entire questionnaire

Field	
Factors to acquire mobile line	0.659
	0.659
ision in choosing or transferring to other cellular provider	0.732
ALL FILEDS	**0.818**

Table (4.5) above shows high values of Cronbach's Alpha for each filed of the questionnaire and the entire questionnaire, which means high reliability of each field of the questionnaire and high reliability for the entire questionnaire. In our study, Cronbach's Alpha equals 0.818 for the entire questionnaire which indicates a very good reliability of the entire questionnaire.

4.3.3 Validity of the Questionnaire

Validity refers to the degree to which an instrument measures what it is supposed to measure. Validity has a number of different aspects and assessment approaches. Statistical validity is used to evaluate instrument validity, which includes criterion-related validity and construct validity.

To insure the validity of the questionnaire, two statistical tests should be applied. The first is the Criterion-related validity test which measures the correlation coefficient between each paragraph in one field and the whole fields. The second, is the structure validity test that is used to test the validity of the questionnaire structure by testing the validity of each field and the validity of the whole questionnaire. It measures the correlation coefficient between one filed and all the fields of the questionnaire that have the same level of similar scale.

4.3.3.1 Internal Validity

Table (4.6): Correlation coefficient of each item of factors to acquire mobile and the total of this field at n = 640

Items	Spearman Correlation Coefficient	Sig.
Easiness of performing jobs	0.454	0.000(**)
Keep in touch with Family and friends	0.506	0.000(**)
Extra Services like Internet and Picture messages	0.704	0.000(**)
Suitable price of Mobile Handset	0.715	0.000(**)
Mobile Handset brand and features	0.752	0.000(**)

** Correlation is significant at the 0.01 level

Table (4.6) above clarifies the correlation coefficient for each item of the factors to acquire mobile and the total of the field, all the coefficients are positive and refer to significance at (0.01), which means a content reliability for what is being measured.

Table (4.7): Correlation coefficient of each item of Importance of services needed and the total of this field at n = 640

Items	Spearman Correlation Coefficient	Sig.
Voice Calls service only	0.260	0.000(**)
Extra Services like internet and e-mail	0.767	0.000(**)
Advanced services like TV Mobile	0.853	0.000(**)
Video Call service	0.820	0.000(**)

** Correlation is significant at the 0.01 level

Table (4.7) above clarifies the correlation coefficient for each item of the Importance of services needed and the total of the field, all the coefficients are positive and refer to significance at (0.01), which means a content reliability for what is being measured.

Table (4.8): Correlation coefficient of each item of factors to switch or choose other provider and the total of this field at n = 640

Items	Spearman Correlation Coefficient	Sig.
Quality of service via Call Centre	0.590	0.000(**)
Network quality and good coverage	0.535	0.000(**)
Tariff suitable prices	0.555	0.000(**)
Availability of new and advanced services	0.760	0.000(**)
Diversity of offers and campaigns	0.754	0.000(**)

** Correlation is significant at the 0.01 level

Table (4.8) above clarifies the correlation coefficient for each item of the factors to switch or choose other provider and the total of the field, all the coefficient are positive and refer to significance at (0.01), which means a content reliability for what is being measured.

4.3.3.2 Structure Validity

The researcher assessed the fields' structure validity by calculating the correlation coefficients of each field of the questionnaire and the whole of questionnaire.

Table(4.9): Correlation coefficients of each field of the questionnaire and the whole of questionnaire.

Fields	Spearman Correlation Coefficient	Sig.
Factors to acquire mobile line	0.839	0.000(**)
Importance of services needed from using Mobile	0.832	0.000(**)
Factors affecting respondent's decision in choosing or transferring to other cellular provider	0.655	0.000(**)

**. Correlation is significant at the 0.05 level .

The correlation coefficient refer to significance at (0.01) level, which means a structure validity for what is being measured as shown in table 4.9 above.

4.4 Data Measurement

In order to be able to select the appropriate method of analysis, the level of measurement must be understood. For each type of measurement, there is an appropriate method that can be applied and not others. In this research, ordinal scales were used. Ordinal scale is a ranking or a rating data that normally uses integers in ascending or descending order. The numbers assigned to the agreement or degree of influence (0,1,2,3,4) do not indicate that the interval between scales are equal, nor do they indicate absolute quantities. They are merely numerical labels. Based on Likert scale we have the following:

Item	Strongly agree		Neutral	Disagree	Strongly
Scale	4	3	2	1	0

4.4.1 Statistical Analysis Tools

The research will use data analysis both qualitative and quantitative data analysis methods. The Data analysis will be made utilizing (SPSS 15). The research will utilize the following statistical tools:

1) Cronbach's Alpha for Reliability Statistics
2) Spearman Rank correlation for Validity
3) Frequency and Descriptive analysis
4) Sign Test.
5) Chi-Square Test for independence.

Chapter Five

Data Analysis and Results

5.1 Introduction

This chapter will analyze historical data and procedures for the regression model building. SAS output results will be presented and discussed thoroughly in the light of the research hypothesis and objectives. Factors which have affected the growth of mobile users in Palestine will be investigated. Two regression models will be developed for this purpose. The first Model will use the mobile users as dependent variable excluding population growth effect. The second Model will consider the potential population implicitly by using ratio of mobile users to potential population as dependent variable.

Along with this analysis, the questionnaire will be analyzed and the results will be used to enhance and support our findings in the regression model.

5.2 Model Data – Scenario 1

The data of past 13 annual observations for mobile users where accompanied with their corresponding data of the four variables which we assume that it may have a significant effect on the dependent variable. Here as listed in table 5.1 below, the dependent variable coded as "CEL" represents the cumulative annual mobile users. The four independent variables in the table are as follows:

- "FIX' ,which represents the cumulative annual Fixed telephone lines in the Palestinian market .
- "GDP" , which represents the annual Growth Domestic Product in US dollars and used as an indicator for the Palestinian economic situation.
- "DIG", which is a dummy variable, indicates the Digitalization presence in the mobile networks operating in the Palestinian market.
- "CMP", which is a dummy variable indicating for competition presence.

Table (5.1) : Annual Historical Data since Dec. 1994 till Dec. 2006

Obs	CEL	FIX	GDP	DIG	CMP	DIG0	DIG1	DIG2
1	6000	58459	1126	0	0	1	0	0
2	15000	59850	1234	0	0	1	0	0
3	41000	61241	1241	0	0	1	0	0
4	53000	110893	1313	0	0	1	0	0
5	71000	167271	1346	0	0	1	0	0
6	96538	222198	1374	1	0	0	1	0
7	341000	272212	1307	1	1	0	1	0
8	393791	292022	1171	1	1	0	1	0
9	544997	301579	1035	1	1	0	1	0
10	659418	252038	1128	2	1	0	0	1
11	903405	290010	1134	2	1	0	0	1
12	936292	348968	1129	2	1	0	0	1
13	1030705	341330	1141	2	1	0	0	1

Source: See Appendix (C)

5.2.1 SAS output – Scenario 1

As shown in Table 5.2 on the next page, it was clearly found that variable "GDP" is excluded from the Stepwise Selection of SAS Regression procedure since it is not significant. The remaining three variables are significant and selected by SAS in stepwise procedure.

The Competition variable "CMP" was the most significant with partial R^2 value of 74.22%, then the Digitalization variable "DIG1" with partial R^2 value of 11.8% and Fixed lines variable "FIX" with partial R^2 value of 9.64%.

This means that 74.22% of variability in mobile users "CEL" is explained by competition "CMP". Then 11.8% more of the variability in "CEL" is explained by Digitalization "DIG1" and 9.64% more of the variability is explained by fixed phone lines "FIX" variable.

It becomes obvious that the total of 95.66% of the variability is explained by those three significant variables above, "CMP","DIG1" and "FIX".

From ANOVA regression, as shown in table 5.2 below, sig. < 0.0001, so there is a significant relationship between "CEL" and all the three variables together .This means that the selected regression model fits the data very well.

Table (5.2) : SAS output for Scenario1

Dependent Variable: CEL

Stepwise Selection: Step 3

Variable FIX Entered: R-Square = 0.9566 and C(p) = 9.6430

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.705521E12	5.68507E11	66.17	<.0001
Error	9	77321324959	8591258329		
Corrected Total	12	1.782842E12			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-171363	71214	49745649470	5.79	0.0395
FIX	2.45747	0.54943	1.718721E11	20.01	0.0015
CMP	276204	111920	52324386851	6.09	0.0357
DIG1	-360147	60310	3.063666E11	35.66	0.0002

Bounds on condition number: 5.0236, 32.719

All variables left in the model are significant at the 0.1500 level.

No other variable met the 0.0500 significance level for entry into the model.

Summary of Stepwise Selection

Step	Variable Entered	Variable Removed	Number Vars In	Partial R-Square	Model R-Square	F Value	Pr > F
1	CMP		1	0.7422	0.7422	31.68	0.0002
2	DIG1		2	0.1180	0.8602	8.44	0.0157
3	FIX		3	0.0964	0.9566	20.01	0.0015

5.2.2 Model Equation for Scenario 1

The final model equation for scenario1 can be written now from the SAS output results in the previous Table 5.2 as follows :

CEL_predicted = -171363 + 2.45747 FIX + 276204 CMP -360147 DIG1	…(5.1)
R^2	0.9566
Adj. R^2	0.9422
F-Test	66.17
Sig.	0.0001

From the above equation (5.1) we can get the following vital data about the predicted mobile users ”CEL” as a final model :

- Competition “CMP” is clearly correlating positively with the growth of mobile users since it has a positive coefficient value. It is also seen from the SAS output in Table 5.2 that “CMP” has sig=0.0002 , which means that there is a significant relationship between mobile users “CEL” and competition “CMP” .This result supports our research hypothesis H4 .

- “DIG1” is negatively correlated with the mobile growth, which implies, in contrast, that Digitalization is positively correlated with the mobile growth. SAS output in Table 5.2 shows that “DIG1” has sig=0.0157 , which confirms a significant relationship with mobile users “CEL”. This result supports our research hypothesis H3 .

- Fixed phone lines “FIX” is positively correlating with mobile growth since it has a positive coefficient value. It is also seen from SAS output in Table 5.2 that “FIX” has sig=0.0015 , which means that there is a significant relationship between mobile users “CEL” and Fixed phone lines “FIX”. This result supports our research hypothesis H2.

5.2.3 Analysis of Variance for Scenario 1

As shown in Table 5.3 on the next page, the value of Adjusted R^2 is 0.9422. This implies that 94.22% of the variability in mobile users “CEL” is explained by all the three variables together “FIX”, ”CMP” and “DIG1”. The remaining percentage, 5.78 % of the variability in “CEL” is due to some error factors which may be explained by other reasons which may affect the mobile users “CEL”.

Table (5.3): Analysis of Variance for Scenario1

Dependent Variable: CEL

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.705521E12	5.68507E11	66.17	<.0001
Error	9	77321324959	8591258329		
Corrected Total	12	1.782842E12			

Root MSE	92689	R-Square	0.9566
Dependent Mean	391704	Adj R-Sq	0.9422
Coeff Var	23.66306		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation	95% Confidence Limits	
Intercept	1	-171363	71214	-2.41	0.0395	0	-332461	-10265
FIX	1	2.45747	0.54943	4.47	0.0015	5.02364	1.21457	3.70037
CMP	1	276204	111920	2.47	0.0357	4.71045	23024	529384
DIG1	1	-360147	60310	-5.97	0.0002	1.17240	-496577	-223717

5.2.4 Multi-co linearity Test for Scenario 1

Here, we consider testing for the presence of multicollinearity in the selected model. From Table 5.3 and as shown below in Table 5.4 , the Variance Inflation Factors (VIF), for the subset (FIX, CMP, DIG-1) is less than 10.

Table (5.4): Variance Inflation Factors (VIF) – Scenario 1

Variable	**Co-linearity Statistics $(VIF)_k$**
" FIX"	5.02364
"CMP"	4.71045
"DIG-1"	1.17240

From these results, we can say that, all variance inflation factors are small and less than 10, so multicollinearity among the three explanatory variables in the subset (FIX, CMP, DIG-1) is not presented.

5.2.5 Correlations Coefficients for Scenario 1

There is a positive significant correlation between mobile users "CEL" dependent variable and each of the independent variables, Fixed Phone lines "FIX", Competition "CMP" and Digitality "DIG". Regarding GDP variable, it has a negative correlation with "CEL" as shown in Table 5.5 below.

Table (5.5): Correlation coefficients for Scenario 1

Correlations

		POT	FIX	GDP	CMP	DIG
CEL	Pearson Correlation	.878**	.859**	-.614*	.862**	.937**
	Sig. (2-tailed)	.000	.000	.026	.000	.000
		13	13	13	13	13

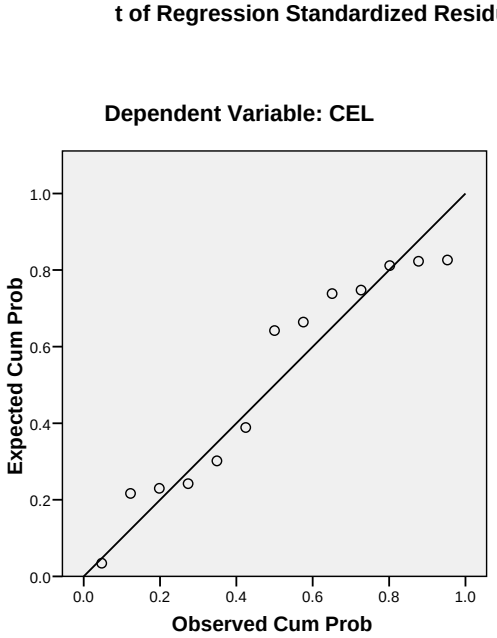
**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

5.2.6 Normality for Scenario 1

It is clear from Figure (5.1) below that mobile users "CEL" variable is roughly normally distributed since the points lie on the normal line or close to it .

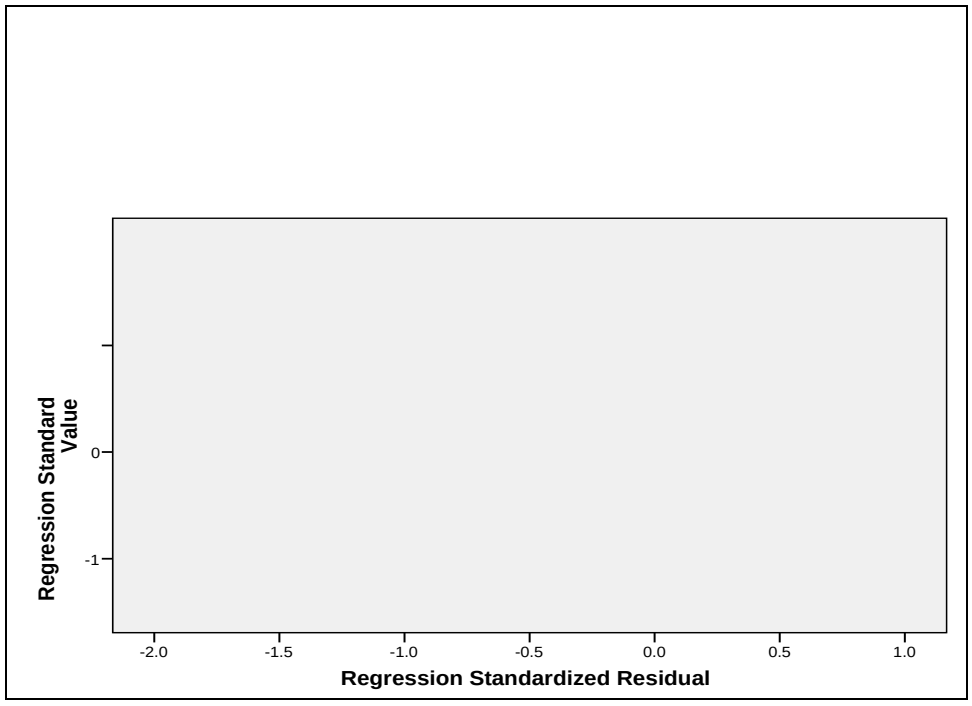
Figure (5.1): Normal Plot of Regression Standardized Residual for Scenario 1



5.2.7 Variance of Dependent Variable "CEL" in Scenario 1

Variance of mobile users "CEL" is constant for each value of the independent variables because from Figure 5.2 below, it is shown clearly that the points are scattered randomly around the Zero line.

Figure (5.2) : Regression of standardized predicted Vs. Standardized Residual



5.2.8 Forecast Results for Scenario 1

To get the forecasted value for the mobile users "CEL" for the next 10 years , we have to operate our final model in equation (5.1) . The future values of "CMP" and "DIG1" are easily found . It is obvious that the competition will continue and the systems will be pure digital. The only independent variable we have to get its future value is the fixed phone lines "FIX". Once we get "FIX" values for the next 10 years, it becomes easily to forecast "CEL" values for the same period in the future.

To get forecast for the "FIX" variable, we suggest using regression with time only since it's Adjusted R^2 =0.883 as shown in Table 5.6 below.

5.2.8.1 Forecasting "FIX" phone lines.

We use SPSS to develop a regression model for "FIX" variable with time only to get a forecasted "FIX" for the next 10 years. Table 5.6 below shows that the coefficients of this model and its equation can be written as follows:

FIX_predicted= -52,750,774.76 + 26,482.24 TIME …(5.2)

Table (5.6) : Coefficients for "FIX" forecast

Coefficients[a]

		Coefficients		Coefficients		
		B	Std. Error	Beta	t	Sig.
1		-5E+007	5534905		-9.531	.000
	TIME	26482.24	2767.448	.945	9.569	.000

a. Dependent Variable: FIX

R^2 =0.893 , Adj. R^2 =0.883

From equation (5.2) , we can operate the model and get the following forecasted "FIX" values for next 10 years .

Table (5.7) : Forecasted Fixed phone lines by time only

Year	"FIX" forecasted
2007	399074
2008	425556
2009	452038
2010	478521
2011	505003
2012	531485
2013	557967
2014	584450
2015	610932
2016	637414

5.2.8.2 SAS output statistics based on Scenario 1

Now we can run and operate our forecasting model based on Scenario 1 to get predicted mobile users "CEL" for the next 10 years. The corresponding values of "FIX" are provided as input for SAS code along with other future values of "CMP" and "DIG1" which is 1 and 0 respectively. See appendix A for SAS code input.

Table (5.8): Forecasted figures – Scenario 1

Year	Actual_CEL	Point	LICI_CEL	UICI_CEL
1994	6,000	-27,702	-263,543	208,140
1995	15,000	-24,283	-259,676	211,109
1996	41,000	-20,865	-255,821	214,090
1997	53,000	101,153	-126,401	328,708
1998	71,000	239,700	684	478,717
1999	96,538	14,535	-257,909	286,978
2000	341,000	413,647	170,885	656,408
2001	393,791	462,329	223,963	700,695
2002	544,997	485,815	248,683	722,948
2003	659,418	724,217	489,042	959,392
2004	903,405	817,532	586,386	1,048,678
2005	936,292	962,419	718,822	1,206,016
2006	1,030,705	943,649	702,883	1,184,415
2007	--	***1,085,553***	***815,729***	***1,355,377***
2008	--	***1,150,632***	***862,439***	***1,438,824***
2009	--	***1,215,710***	***906,726***	***1,524,695***
2010	--	***1,280,792***	***949,046***	***1,612,538***
2011	--	***1,345,870***	***989,772***	***1,701,968***
2012	--	***1,410,949***	***1,029,213***	***1,792,685***
2013	--	***1,476,028***	***1,067,608***	***1,884,447***
2014	--	***1,541,109***	***1,105,153***	***1,977,064***
2015	--	***1,606,187***	***1,141,995***	***2,070,380***
2016	--	***1,671,266***	***1,178,256***	***2,164,276***

From Table 5.8 above, and based on Scenario 1 , we can say that by the end of 2007, we are 95% confident that mobile users "CEL" will lie between 815729 and 1,355,377 .

Similarly, by the end of 2008, we are 95% confident that mobile users "CEL" will lie between 862,439 and 1,438,824 and so on till the end of 2016.
That is , by the end of 2016, we are 95% confident that mobile users "CEL" will lie between 1,178,256 and 2,164,276.

5.3 Model Data – Scenario 2

Here ,we consider the population growth into the regression model by incorporating the potential population into the dependent variable implicitly. The new dependent variable in this model is a ration between the mobile users "CEL" and the Potential population "POT"

$$Ratio_{(t)} = CEL_{(t)} / POT_{(t)} \quad \ldots (5.3)$$

Where :

$CEL_{(t)}$: Mobile users at time t.

$POT_{(t)}$: Potential population at time t.

The potential population refers to those people living in WBG and has coverage from mobile operators. This figure can be calculated as follows:

$$POT_{(t)} = COV_{(t)} * POP_{(t)} \quad \ldots.(5.4)$$

Where:

$COV_{(t)}$: Mobile coverage percentage at time t.

$POP_{(t)}$: Palestinian Population at time t.

We use the same data of the previous Table 5.1, and the same independent variable of Scenario1, but our new dependent variable is "Ratio" as described in Equation(5.3).

5.3.1 SAS output – Scenario 2

As shown in Table 5.9 on the next page, again, the independent variable "GDP" is excluded from the Stepwise Selection of SAS Regression procedure since it is not significant. The remaining three variables are significant and selected by SAS in stepwise. Competition variable "CMP" was the most significant with partial R^2 value of 82.41%, then Digitalization variable "DIG1" with partial R^2 value of 7.61% and Fixed lines variable "FIX" with partial R^2 value of 7.01%.

This means that 82.41% of variability in "ratio" is explained by competition "CMP". Then 7.61% more of the variability in "ratio" is explained by Digitalization "DIG1", and 7.01% more of the variability is explained by fixed phone lines "FIX" variable.
It becomes obvious that total of 97.03% of variability is explained by those above three significant variables, "CMP","DIG1" and "FIX".

From ANOVA regression, as shown in table 5.9 below, sig. < 0.0001 , so there is a significant relationship between "ratio" and all the three variables together .This means that the selected regression model fits the data very well.

Table (5.9) : SAS output for Scenario 2

Dependent Variable: ratio

Stepwise Selection: Step 3

Variable FIX Entered: R-Square = 0.9703 and C(p) = 8.8099

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.11016	0.03672	98.02	<.0001
Error	9	0.00337	0.00037462		
Corrected Total	12	0.11354			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-0.02226	0.01487	0.00083929	2.24	0.1687
FIX	5.289015E-7	1.147309E-7	0.00796	21.25	0.0013
CMP	0.09094	0.02337	0.00567	15.14	0.0037
DIG1	-0.07392	0.01259	0.01290	34.45	0.0002

Bounds on condition number: 5.0236, 32.719

All variables left in the model are significant at the 0.1500 level.

No other variable met the 0.0500 significance level for entry into the model.

Summary of Stepwise Selection

Step	Variable Entered	Variable Removed	Number Vars In	Partial R-Square	Model R-Square	F Value	Pr > F
1	CMP		1	0.8241	0.8241	51.52	<.0001
2	DIG1		2	0.0761	0.9002	7.63	0.0201
3	FIX		3	0.0701	0.9703	21.25	0.0013

5.3.2 Model Equation for Scenario 2

The final model equation for this scenario2 can be written now from the SAS output results in the previous Table 5.9 as follows :

ratio_predicted= -0.02226 + 5.289015E-7FIX + 0.09094 CMP -0.07392 DIG1 (5.5)

R^2	0.9703
Adj. R^2	0.9604
F-Test	98.02
Sig.	0.0001

From above equation we can get the following vital data about the predicted mobile users ”CEL” as a final model :

- Competition “CMP” is clearly correlates positively with the growth of mobile users since it has a positive coefficient value. It is also seen from SAS output in Table 5.9 that “CMP” has sig < 0.0001 , which means that there is a significant relationship between “ratiol” and competition “CMP” .This result still supports our research hypothesis H4 .
- “DIG1” is negatively correlates with “ratio”, which implies, in contrast, that Digitalization is positively correlates with it . SAS output in Table 5.9 shows that “DIG1” has sig=0.0201 , which confirms a significant relationship with “ratio”. Also, this result still supports our research hypothesis H3 .
- Fixed phone lines “FIX” is positively correlates with mobile growth since it has a positive coefficient value. It is also seen from SAS output in Table 5.9 that “FIX” has sig=0.0013 , which means that there is a significant relationship between “ratio” and Fixed phone lines “FIX”. This result still supports our research hypothesis H2.

5.3.3 Analysis of Variance for Scenario 2

As shown in Table 5.10 below, the value of Adjusted R^2 is 0.9604. This implies that 96.04% of the variability in “ratio” is explained by all the other three variables together “FIX”, ”CMP” and “DIG1” as well as the population growth. The remaining percentage, 3.96 % of the variability in “ratio” is due to some error factors which may be explained by other reasons that may affect the “ratio”.

Table (5.10): Variance analysis for Scenario 2

Dependent Variable: ratio

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.11016	0.03672	98.02	<.0001
Error	9	0.00337	0.00037462		
Corrected Total	12	0.11354			

Root MSE	0.01936	R-Square	0.9703
Dependent Mean	0.11699	Adj R-Sq	0.9604
Coeff Var	16.54445		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation	95% Confidence Limits	
Intercept	1	-0.02226	0.01487	-1.50	0.1687	0	-0.05590	0.01138
FIX	1	5.289015E-7	1.147309E-7	4.61	0.0013	5.02364	2.693621E-7	7.884409E-7
CMP	1	0.09094	0.02337	3.89	0.0037	4.71045	0.03807	0.14380
DIG1	1	-0.07392	0.01259	-5.87	0.0002	1.17240	-0.10240	-0.04543

5.3.4 Multi-co linearity Test for Scenario 2.

Here we consider testing for the presence of multicollinearity in the selected model. From Table 5.10 and as shown below in Table 5.11, the Variance Inflation Factors (VIF), for the subset (FIX, CMP, DIG-1) is less than 10.

Table (5.11): Variance Inflation Factors (VIF) – Scenario 2

Variable	**Co linearity Statistics $(VIF)_k$**
" FIX"	5.02364
"CMP"	4.71045
"DIG-1"	1.17240

From these results, we can say that, all variance inflation factors are small and less than 10, so multicollinearity among the three explanatory variables in the subset (FIX, CMP, DIG-1) is not present.

5.3.5 Correlations Coefficients for Scenario 2

There is a positive significant correlation between "ratio" dependent variable and each of independent variables; Population covered "POT", Fixed Phone lines "FIX", Competition "CMP" and Digitality "DIG". Regarding GDP variable, it has a negative correlation with "Ratio" as shown in Table 5.12 below.

Table (5.12): Correlation coefficients for Scenario 2

Correlations

	POT	FIX	GDP	DIG	CMP
	.978**	.888**	-.612*	.944**	.908**
	.000	.000	.026	.000	.000
	13	13	13	13	13

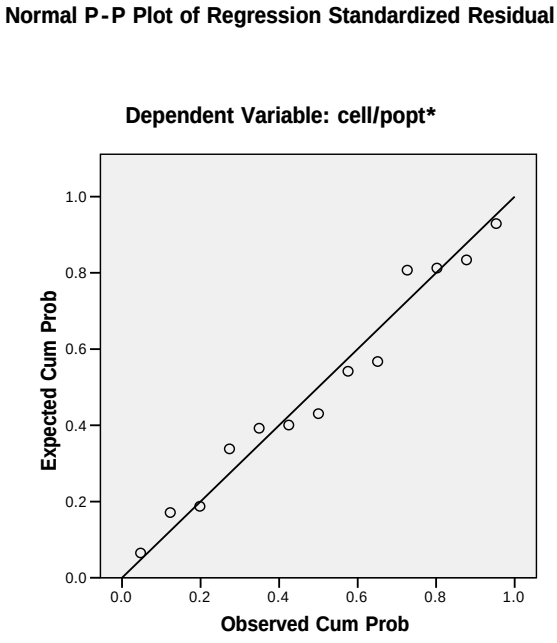
**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

5.3.6 Normality for Scenario 2.

It is clear from Figure(5.3) below that "ratio" variable is roughly normally distributed since the points lie on the normal line or close to it .

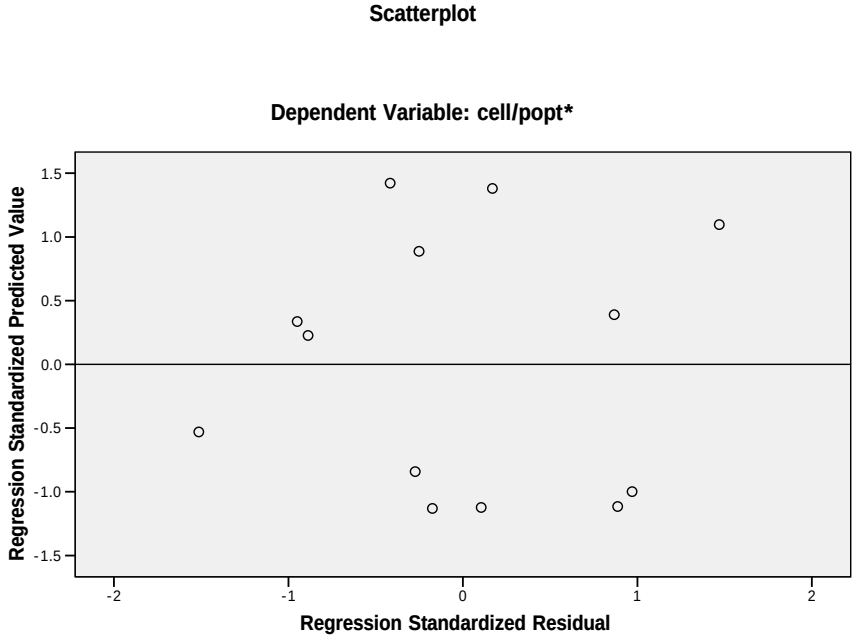
Figure (5.3): Normal Plot of Regression Standardized Residual for Scenario 2



5.3.7 Variance of Dependent Variable "ratio" in Scenario 2

Variance of 'ratio" is constant for each value of the independent variables because from Figure 5.4 below, it is shown clearly that the points are scattered randomly around the Zero line.

Figure (5.4) : Regression of standardized predicted Vs. Standardized Residual for Scenario 2



5.3.8 Forecast Results for Scenario 2

To get the forecasted value of the mobile users for the next 10 years , we have to operate our final model in equation (5.5) to get the forecasted value of "ratio". Then substitute this value of "ratio" into equation (5.3) to get correspondent value of "CEL". The future values of "POT" are already provided in Appendix (C) and shown on the next page in Table 5.13.

Regarding the future values of "CMP" and "DIG1", they are easily found. It is obvious that competition will continue and the systems will be pure digital.

Regarding "FIX" independent variable we get its future value as previously calculated in Table 5.6. Once we get "FIX" values for the next 10 years, it becomes easy to forecast "ratio" values for the same period in the future.

5.3.8.1 Future values of Potential Population

To get the predicted mobile users "CEL" from the forecasted value "ratio", we have to work with Equations (5.4) and (5.3) respectively. From Equation (5.4) we get the future value of POT by substituting for COV and POP future values as stated in Appendix (C) and (D) . Then, substitute for POT in Equation (5.3) to get the corresponding value of predicted "CEL" .

Table (5.13) : Future values of Potential Population POT

Year	Assumed * "COV" %	Forecasted ** "POP"	Calculated "POT"
2007	0.96	4,491,723	4,312,054
2008	0.97	4,690,090	4,549,387
2009	0.97	4,891,902	4,745,145
2010	0.98	5,084,238	4,982,553
2011	0.98	5,293,646	5,187,773
2012	0.98	5,411,927	5,303,688
2013	0.99	5,571,654	5,515,937
2014	0.99	5,732,859	5,675,530
2015	0.99	5,895,280	5,836,327
2016	0.99	6,053,635	5,993,099

* Estimated from researcher experience in the filed

** Source : PCBS(1997-2024) , see appendix (D)

5.3.8.2 SAS output statistics based on Scenario 2

Now we can run and operate our forecasting model based on Scenario 2 to get the predicted "ratio" for the next 10 years. The corresponding future values of "FIX" are provided as input for SAS code along with other future values of "CMP" and "DIG1" which is 1 and 0 respectively. See appendix (B) for SAS code input.

Table (5.14): Forecasted "ratio" – Scenario 2

Dependent Variable: ratio

Output Statistics

Obs	Dependent Variable	Predicted Value	Std Error Mean Predict	95% CL Predict	
1994	0.005280	0.008661	0.009966	-0.0406	0.0579
1995	0.0114	0.009396	0.009875	-0.0398	0.0586
1996	0.0273	0.0101	0.009786	-0.0389	0.0592
1997	0.0311	0.0364	0.008161	-0.0111	0.0839
1998	0.0369	0.0662	0.0106	0.0163	0.1161
1999	0.0401	0.0213	0.0161	-0.0355	0.0782
2000	0.1216	0.1387	0.0113	0.0880	0.1894
2001	0.1308	0.1492	0.0105	0.0994	0.1990
2002	0.1711	0.1543	0.0102	0.1047	0.2038
2003	0.1971	0.2020	0.009831	0.1529	0.2511
2004	0.2505	0.2221	0.008980	0.1738	0.2703
2005	0.2452	0.2532	0.0114	0.2024	0.3041
2006	0.2525	0.2492	0.0109	0.1989	0.2995
2007	.	0.2797	0.0157	0.2234	0.3361
2008	.	0.2938	0.0183	0.2336	0.3539
2009	.	0.3078	0.0209	0.2432	0.3723
2010	.	0.3218	0.0237	0.2525	0.3910
2011	.	0.3358	0.0266	0.2614	0.4101
2012	.	0.3498	0.0294	0.2701	0.4295
2013	.	0.3638	0.0324	0.2785	0.4491
2014	.	0.3778	0.0353	0.2868	0.4688
2015	.	0.3918	0.0382	0.2949	0.4887
2016	.	0.4058	0.0412	0.3029	0.5088

Following table state the calculated future values of "CEL" according to "ratio" values in the SAS output in previous table 5.14. The values are shown in three shapes, Lower Individual Confidence Interval (LICI) , Upper Individual Confidence Interval(UICI) and point .

From Table 5.15 in the next page, and based on Scenario 2 , we can say that by the end of 2007, we are 95% confident that mobile users "CEL" will lie between ***963,324*** and ***1,449,216***.

Similarly, by the end of 2008, we are 95% confident that mobile users "CEL" will lie between ***1,062,614*** and ***1,610,147*** and so on till the end of 2016. That is , by the end of 2016, we are 95% confident that mobile users "CEL" will lie between ***1,815,032*** and ***3,048,938***.

Table (5.15) : Corresponding "CEL" predicted values in Scenario 2

Year	Actual_CEL	Point	LICI_CEL	UICI_CEL
1994	6,000	9,842	-46,114	65,797
1995	15,000	12,339	-52,198	76,875
1996	41,000	15,221	-58,472	88,912
1997	53,000	62,020	-18,954	142,993
1998	71,000	127,328	31,350	223,305
1999	96,538	51,365	-85,520	188,250
2000	341,000	389,197	246,994	531,399
2001	393,791	449,099	299,294	598,904
2002	544,997	491,525	333,761	649,290
2003	659,418	675,704	511,423	839,984
2004	903,405	800,855	626,790	974,920
2005	936,292	967,138	772,885	1,161,390
2006	1,030,705	1,017,303	812,076	1,222,531
2007	--	***1,206,270***	***963,324***	***1,449,216***
2008	--	***1,336,381***	***1,062,614***	***1,610,147***
2009	--	***1,460,344***	***1,154,196***	***1,766,492***
2010	--	***1,603,196***	***1,258,050***	***1,948,341***
2011	--	***1,741,887***	***1,356,146***	***2,127,627***
2012	--	***1,855,090***	***1,432,338***	***2,277,843***
2013	--	***2,006,585***	***1,536,182***	***2,476,988***
2014	--	***2,144,135***	***1,627,488***	***2,660,782***
2015	--	***2,286,625***	***1,720,929***	***2,852,320***
2016	--	***2,431,985***	***1,815,032***	***3,048,938***

5.4 Comparison of two scenario Models

In comparison to Table 5.16 on the next page, we notice that R^2 for the Model Scenario 2 is higher than that of the Model Scenario 1. This would let us prefer this model in practical life. The other main difference between the two model scenarios is the incorporation of potential population into account. This is an important factor to be considered since the population growth rate in Palestine is one of the highest rates in the region. The incorporation of this population effect makes the model more reliable and confident as seen from Model Scenario 2.

Table (5.16) : Comparison of two scenario Models

	Scenario 1			**Scenario 2**		
Dependent Variable	Mobile Users "CEL"			Ratio of "CEL" to Potential Population		
Independent Variable	FIX , CMP , DIG , GDP			FIX , CMP , DIG , GDP		
R^2	0.9566			0.9703		
Adjusted R^2	0.9422			0.9604		
Confidence Level	***Point***	***Lower***	***Upper***	***Point***	***Lower***	***Upper***
*Forecast **2007***	1,085,553	815,729	1,355,377	1,206,270	963,324	1,449,216
Penetration %	**24.2%**	18.2%	30.2%	**27.6%**	19.5%	35.8%
*Forecast **2016***	1,671,266	1,178,256	2,164,276	2,431,985	1,815,032	3,048,938
Penetration %	**26.9%**	21.4%	32.3%	**40.2%**	30%	50.4%

5.4.1 Conclusion

Both model scenarios clearly prove the positive effect of Competition, Fixed phones and Digitalization on mobile diffusion. The effect of GDP was not significant in both models. The Model Scenario 2 is superior to Model Scenario 1 since it is incorporating implicitly the effect of the population growth and coverage percentage as the potential population effect.

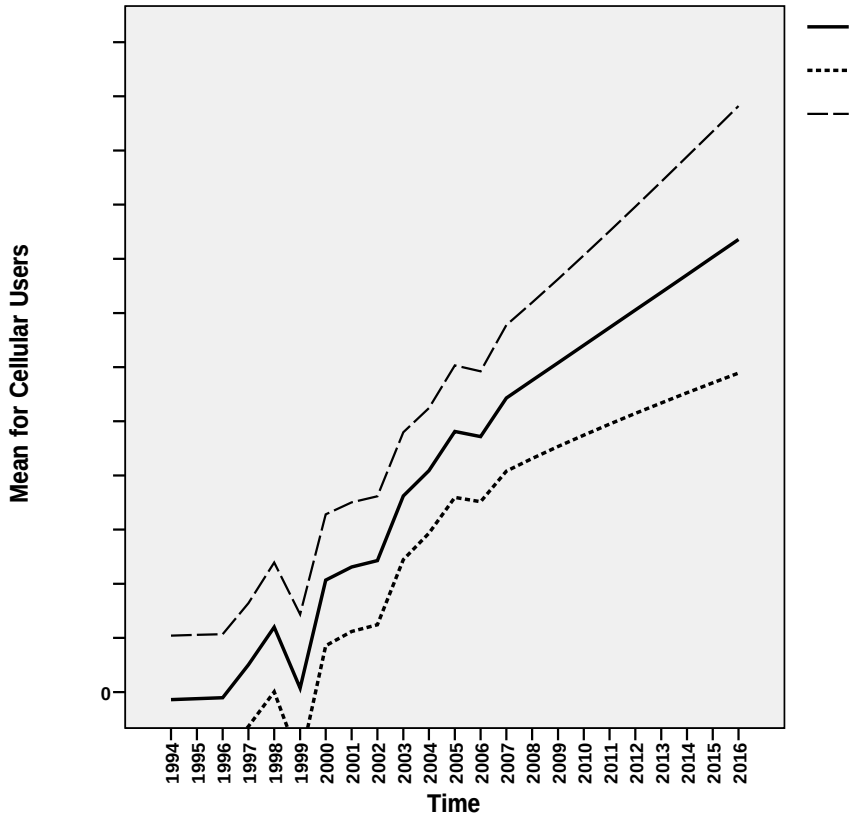
5.5 Future of Mobile Diffusion.

It is clear from both scenarios that the shape of Mobile Diffusion follows the trend of Sigmoid or S-shape.

5.5.1 Future Mobile Diffusion based on Scenario 1

As shown in Table 5.17, the mobile penetration rate is predicted to reach 27.6% by end of year 2016 based on Scenario 1.

Figure (5.5) : Actual, predicted and confidence interval of Scenario 1



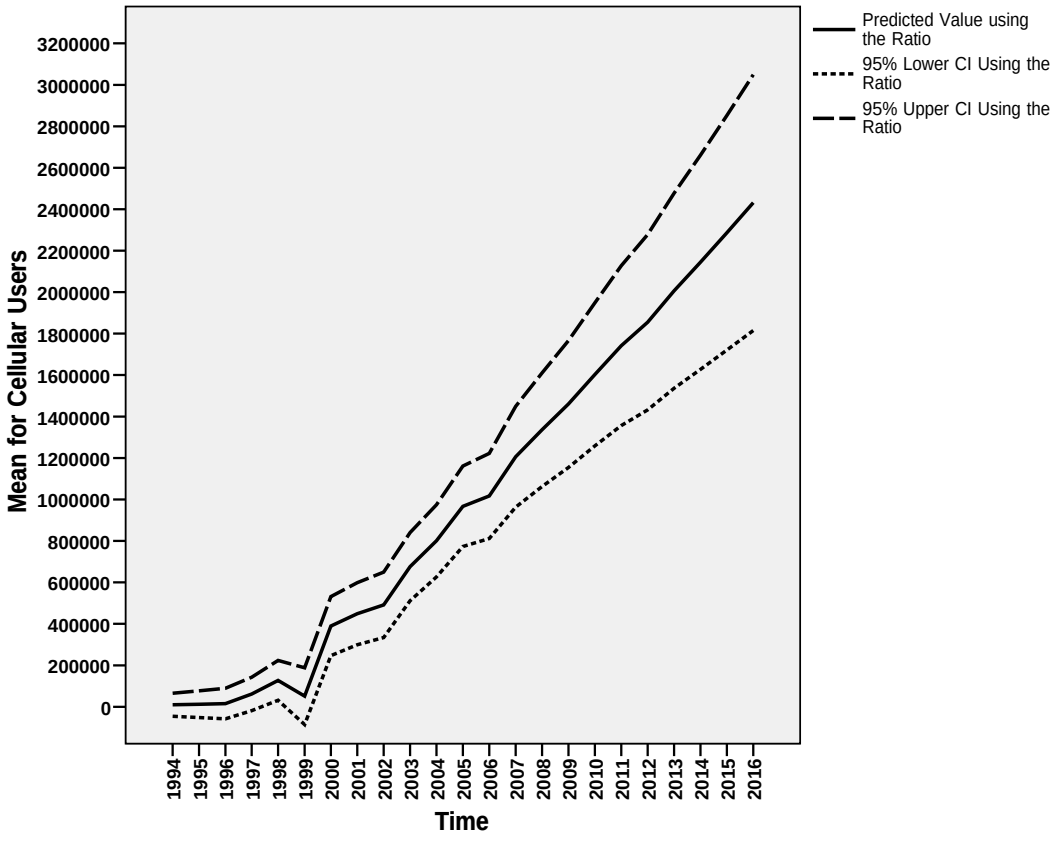
The prediction of the years 2005 and 2006 can be compared to the actual data. For the year 2005, Model Scenario 1 predicts 0.962 million Mobile Users, whereas the actual figure was 0.936 million , and for the year 2006, the prediction is 0.944 million, compared to the actual 1.031 million.

The confidence interval widens because the uncertainty of the prediction increases as further predictions are made.

5.5.2 Future Mobile Diffusion based on Scenario 2

As shown in Table 5.18 , the mobile penetration rate is predicted to reach 40.2 % by end of year 2016 based on Scenario 2.

Figure (5.6) : Actual, predicted and confidence interval of Scenario 2



For Model Scenario 2, the prediction of the years 2005 and 2006 can be compared to the actual data. For the year 2005, it predicts 0.967 million Mobile Users, whereas the actual figure was 0.936 million, and for the year 2006, the prediction is 1.017 million, compared to the actual 1.031 million. These small deviations indicate that the constructed Model Scenario 2 seems to provide rather accurate forecasts.

Again, the confidence interval widens because the uncertainty of the prediction increases as further predictions are made.

Table (5.17) : Forecasted diffusion of Mobile users and their penetration rate – Scenario 1

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Lower Limit	815,729	862,439	906,726	949,046	989,772	1,029,213	1,067,608	1,105,153	1,141,995	1,178,256
	18.2%	***18.4%***	***18.5%***	***18.7%***	***18.7%***	***19.0%***	***19.2%***	***19.3%***	***19.4%***	***19.5%***
Point	1,085,553	1,150,632	1,215,710	1,280,792	1,345,870	1,410,949	1,476,028	1,541,109	1,606,187	1,671,266
	24.2%	***24.5%***	***24.9%***	***25.2%***	***25.4%***	***26.1%***	***26.5%***	***26.9%***	***27.2%***	***27.6%***
Upper Limit	1,355,377	1,438,824	1,524,695	1,612,538	1,701,968	1,792,685	1,884,447	1,977,064	2,070,380	2,164,276
	30.2%	***30.7%***	***31.2%***	***31.7%***	***32.2%***	***33.1%***	***33.8%***	***34.5%***	***35.1%***	***35.8%***

Table (5.18) : Forecasted diffusion of Mobile users and their penetration rate – Scenario 2

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Lower Limit	963324	1062614	1154196	1258050	1356146	1432338	1536182	1627488	1720929	1815032
	21.4%	***22.7%***	***23.6%***	***24.7%***	***25.6%***	***26.5%***	***27.6%***	***28.4%***	***29.2%***	***30.0%***
Point	1,206,270	1,336,381	1,460,344	1,603,196	1,741,887	1,855,090	2,006,585	2,144,135	2,286,625	2,431,985
	26.9%	***28.5%***	***29.9%***	***31.5%***	***32.9%***	***34.3%***	***36.0%***	***37.4%***	***38.8%***	***40.2%***
Upper Limit	1449216	1610147	1766492	1948341	2127627	2277843	2476988	2660782	2852320	3048938
	32.3%	***34.3%***	***36.1%***	***38.3%***	***40.2%***	***42.1%***	***44.5%***	***46.4%***	***48.4%***	***50.4%***

5.6 Questionnaire Analysis

5.6.1 Respondents' Age.

The majority of sample respondents belong to young generations between 18-25 years. Next majority still belongs to next generation between 26-40 years. This means that total of 82.9% of respondents belong to the age interval between 18 – 40 years. Keeping in mind that according to PCBS (2006) those who are under 18 years old represent 52.3% of Palestinian population by the end of 2006. This implies the youth nature of the Palestinian people. The younger generations are expected to be the most likely potential adopters for mobile services.

Table (5.19) : Age distribution of respondents

Age		
		Percent
	Less than 18 years	3.9
	18 - 25 years	41.7
	26- 40 years	41.2
	41 - 50 years	9.3
	51 years and above	3.9
	Total n=636	100.0

5.6.2 Respondents' Gender.

The majority of the respondents were males since they are representing 75.2% of the respondents as shown in Table 5.10 below. This result reflects that most of the mobile users are males. Meanwhile, the statistic of PCBS (2007) shows that male percentage in the Palestinian population is almost 50%.

Table (5.20) : Gender distribution.

Sex		
		Percent
	Male	75.2
	Female	24.8
	Total n=604	100.0

5.6.3 Respondents' Monthly Income

Those who have monthly income less than 1000 NIS are 35.8% of respondents. There is a majority of 28.6% of respondents with monthly income of 1000 NIS and less than 2000 NIS. Next, there is a fewer majority of 25.9% for those with monthly income of 2000 NIS to 4000 NIS. Only 9.7 % of respondents are with monthly income above 4000 NIS.

Table (5.21) : Respondents' Monthly Income

Income	
	Percent
Less than 400 NIS	19.2
400 till less than 1000 NIS	16.6
1000 till less than 2000 NIS	28.6
2000 NIS to 4000 NIS	25.9
Above 4000 NIS	9.7
Total n=609	100.0

5.6.4 Geographical distribution

The majority of respondents with percentage of 59.2% are living in Gaza region. Remaining 40.8% are living in West Bank region. The reason for this high percentage of response in Gaza region is due to availability of researcher in that place and easiness of distributing and collecting more responses. According to PCBS (2007) , the Palestinian population exceeds four millions , and about 62% of them are living in West Bank area.

Table (5.22) : Geographical distribution of respondents.

Location	
	Percent
Gaza	59.2
West Bank	40.8
Total n=604	100.0

5.6.5 Respondents' Occupation

The majority of 43.3% of respondents are employed in the private sector. Only 17.3% of respondents belong to the Government sector. A good percentage of 22.7% of respondents are students. Only 5.5% of respondents are jobless.

Table (5.23) : Occupation distribution among respondents.

Occupation	
	Percent
Student	22.7
Government Employee	17.3
Private Sector employee	43.3
General Business	11.2
Unemployed	5.5
Total n=635	100.0

5.6.6 Mobile service provider distribution

There is a majority of 78.9% of respondents subscribed exclusively to Jawwal, while 9.1% of total respondents are subscribed to Israeli cellular. This majority of Jawwal respondents is obvious since they have almost 70% market share (Arabadvisors, 2007).

There is 7.4% of respondents having subscription in both Jawwal as well as Israeli cellular. Only 4.6% of respondents do not have mobile service.

Table (5.24) : Mobile service provider distribution among respondents

Mobile Service Provider	
	Percent
Jawwal Only	78.9
Israeli Cellular	9.1
Jawwal + Israeli Cellular	7.4
Don't Have	4.6
Total n=634	100.0

5.6.7 Respondents having more than one mobile line

There is a majority of 56.1 % of respondents having single mobile line. Those who have more than one line are 33.8% of respondents.

Table (5.25) : Respondents having multiple mobile lines

Multiple Mobile Line		
		Percent
	Yes	33.8
	One Only	56.1
	Don't Have any	10.1
	Total n=631	100.0

5.6.8 Importance of having a Mobile line

There is a majority with 86.7% of respondents believes that having a mobile line is a necessity. Only 13.3% of respondents consider mobile is a luxury.

Table (5.26): Importance of owing Mobile line.

Importance		
		Percent
	Necessity	86.7
	Luxury	13.3
	Total n=638	100.0

5.6.9 Respondents' Preferences regarding Mobile vs. Fixed line

There is high proportion of respondents with 44.5% prefer to use both Fixed and Mobile for communication purposes. Those who prefer mobile line are 41% of respondents, while 13.9% of respondents prefer Fixed phone exclusively for communication purposes. This will lead us to a conclusion that both services are complements at this stage of responses.

Gruber's study (2001) , indicates that mobile telecommunications were conceived in the early years as a complementary service to fixed telecommunications, mainly for businessmen and wealthy people. However, as mobile telecommunications become a widely spread service and tariff comparable to fixed, substitution effect may become predominant. Also , in the study of Jang et.al(2005) they indicate that since 1988, the complementarity has transformed itself into substitutability in OECD countries.

Table (5.27): Mobile vs. Fixed lines preferences.

Communication Preferences		
		Percent
	Mobile Line	41.0
	Fixed Phone	13.9
	Both (Fixed+Mobile)	44.5
	Don't Have any.	0.6
	Total n= 634	100.0

5.6.10 Opinion of Respondents having cellular services

The following five sub-sections will show the response for those having mobile service. It measures some general characteristics of mobile users such as their service type, monthly expenditure, general satisfaction, and the nature of usage and the period of using their mobile service.

5.6.10.1 Service Type

The majority of 59% of mobile users have a prepaid line, while 27.5% have post-paid line. Those who have both service types reach 13.4% of total respondents.

This is obvious and common in almost all mobile markets that Prepaid subscribers are the majority. In Palestine, the prepaid segment subscribers represent about 90% of the market till the end of 2006.

Table (5.28): Service type distribution

Service Type		
		Percent
	Postpaid	27.5
	Prepaid	59.0
	Post+PrePaid	13.4
	Total n=559	100.0

5.6.10.2 Monthly Expenditure

There is a majority of 56.3% of respondents who expend less than 100 NIS per month. Those who have monthly expenditure from 100 NIS to less than 200 NIS represent 23.2% of total respondents. Three is 20.5% of respondents whose monthly expenditure above 200 NIS. For the last 6 years, Jawwal has maintained acceptable monthly Average Revenue per User (ARPU) around 18 $ (US$ ~ 4 NIS).

Table (5.29): Monthly Expenditure distribution

Monthly Expenditure		
		Percent
	Less than 50 NIS	26.0
	50 to less than 100 NIS	30.3
	100 to less than 200 NIS	23.2
	More than 200 NIS	20.5
	Total n= 561	100.0

5.6.10.3 General satisfaction

There is 8.4% of respondents who consider the service bad. Another 12.1% just accept the service. The remaining 59.6% of respondents are satisfied with the services in general.

Table (5.30): Levels of general satisfaction

General Satisfaction		
		Percent
	Bad	8.4
	Acceptable	12.1
	Good	32.6
	Very Good	33.3
	Excellent	13.7
	Total n=562	100.0

5.6.10.4 Nature of Mobile Usage

The majority of respondents of 83.1% use the mobile for both sending and receiving calls. There is 7.2% of respondents using the mobile mainly to generate call, while 9.7% using the mobile mainly to receive calls.

Table (5.31): Nature of Mobile Usage

Usage		
		Percent
	Receiving	9.7
	Sending	7.2
	Send and Receive Calls	83.1
	Total n = 555	100.0

5.6.10.5 Period of Mobile Usage

Only 5.9% of respondents use their mobile since less than one year. 21.7% of respondents use the mobile since a period of 1 year to less than 3 years. There is 33.7% who are using their mobiles since a period of 3 to 6 years. Remaining 38.7% of respondents use their mobiles since more than 6 years.

Table (5.32) : Period of Mobile Usage

Period of Usage		
		Percent
	Less than 1 Year	5.9
	1 Year to less than 3 Years	21.7
	3 to 6 Years	33.7
	More than 6 Years	38.7
	Total n = 561	100.0

5.6.11 Factors to acquire Mobile line

From Table 5.33 below, it is clearly shown that all the five items listed in the table are significant at 0.01 level. They are considered as factors which may push or encourage the respondents to acquire a mobile line . The most effective factor was the easiness of performing jobs with weighted mean of 86.75%. Next effective factor was to keep in touch with family and friends with weighted mean of 83.75%. Next effective two factors were the suitable price of mobile handset with and the mobile handset brand and features weighted mean of 65.5% and 64.5% respectively. The factor of extra services like Internet and picture messages did not show acceptable importance effect to push respondents to acquire mobile line. As shown in Table 5.33 , mobile users strongly disagree that Extra Services like Internet and Picture messages are important because the mean is significantly smaller than 2 with weighted mean of 45% only.

Table (5.33): Factors to acquire Mobile line

#	Item	Strongly Agree %	Agree%	Neutral %	Disagree %	Strongly Disagree %	Mean	Weighted Mean%	Sig.
1-	Easiness of performing jobs	60.6%	29.0%	8.0%	1.9%	0.5%	3.47	86.75%	0.000 **
2-	Keep in touch with Family and friends	53.3%	31.3%	13.2%	1.7%	0.5%	3.35	83.75%	0.000 **
3-	Extra Services like Internet and Picture messages	15.0%	12.8%	26.5%	28.9%	16.7%	1.80	45.00%	0.000 **
4-	Suitable price of Mobile Handset	27.8%	30.5%	22.3%	14.8%	4.6%	2.62	65.50%	0.000 **
5-	Mobile Handset brand and features	28.9%	25.6%	26.3%	13.3%	5.9%	2.58	64.50%	0.000 **
	All Group	**37.2%**	**25.8%**	**19.2%**	**12.1%**	**5.6%**	**2.77**	**69.25%**	**0.000 ** **

** Denotes the mean is significantly different from 2.0 (The midpoint) at 0.01 level

5.6.12 Importance level for some required mobile services

Table 5.34 below explores the level of importance from respondent perspective which he/she would like to have in the mobile. The column of Significance in table 5.34 below shows that only two mobile services denote significance at 0.01 level. The highest importance level for respondents was the Basic voice calls with weighted mean of 75%. It is worth to mention that mobile users strongly disagree that Advanced services like TV Mobile are important because the mean is significantly smaller than 2 with weighted mean of 45.5% only.

Also, mobile users neither agree nor disagree that Extra Services like internet and e-mail and Video Call service are important since the means equal 2 and 2.1, respectively.

Since these services are mainly available and provided by 3G technology, we conclude that the interest in 3G services is on its edge towards majority and importance.

Table (5.34): Importance of needed services from using Mobile

#	Item	Strongly Agree %	Agree%	Neutral %	Disagree %	Strongly Disagree %	Mean	Weighted Mean%	Sig.
1-	Voice Calls service only	41.5%	32.0%	14.6%	8.7%	3.2%	3.00	75.00%	0.000 **
2-	Extra Services like internet and e-mail	18.5%	19.1%	21.3%	26.1%	15.0%	2.00	50.00%	0.347
3-	Advanced services like TV Mobile	17.3%	14.3%	22.7%	28.9%	16.8%	1.86	46.50%	0.000**
4-	Video Call service	22.4%	18.0%	22.4%	21.6%	15.5%	2.1	52.50%	0.367
	Total	24.9%	20.9%	20.3%	21.3%	12.6%	2.25	56.25%	0.000 **

** Denotes the mean is significantly different from 2.0 (The midpoint) at 0.01 level

5.6.13 Factors affecting respondents' decision in choosing or transferring to other service provider

Table 5.35 below shows that all the items listed are significant at .001 level. These items represent the factors which may affect the respondent decision in switching to or choosing other service provider. The most important two factors from respondents' perspective are the network quality and good coverage as well as Tariff suitable prices with weighted mean of 91.5% and 91% respectively. Another important factor was the quality of service via call centre with weighted mean of 86%. Last important factors were the availability of advanced services and diversity of offers with weighed mean of 81% and 75% respectively.

Table (5.35: Factors to choose or switch to other service provider

#	Item	Strongly Agree %	Agree%	Neutral %	Disagree %	Strongly Disagree %	Mean	Weighted Mean%	Sig.
1-	Quality of service via Call Centre	60.3%	27.9%	8.0%	2.7%	1.1%	3.44	86.00%	0.000 **
2-	Network quality and good coverage	77.2%	15.5%	4.3%	2.1%	1.0%	3.66	91.50%	0.000 **
3-	Tariff suitable prices	75.5%	17.4%	4.1%	1.9%	1.1%	3.64	91.00%	0.000 **
4-	Availability of new and advanced services	52.8%	28.1%	12.2%	4.3%	2.5%	3.24	81.00%	0.000 **
5-	Diversity of offers and campaigns	47.6%	22.9%	17.7%	7.9%	3.9%	3.02	75.50%	0.000 **
	Total	62.7%	22.4%	9.3%	3.8%	1.9%	3.40	85.00%	0.000 **

** Denotes the mean is significantly different from 2.0 (The midpoint) at 0.01 level

5.7 Hypotheses Testing

5.7.1 H1 : Higher GDP per capita accelerates the rate of the diffusion of mobile users

Economic growth over the last fifteen years has been dismal, with the high population growth during most of this period (World Bank, Sep. 2006). Although this dismal and unstable economic situation which may not encourage products demand and extra expenditure, the case here in the Palestinian market of mobile industry is totally different. It was clearly depicted from our regression model that GDP was not significant in the model. This fact is also supported and explained by questionnaire analysis.

From Table 5.36 below, we note that by cross tabulation between monthly income and expenditure, there was a total of 55% of overall income levels expend less than 100 NIS per month.

Table (5.36): Cross tabulation between monthly income and expenditure

Income * Expenditure Cross tabulation							
			Monthly Expenditure				
			< 50 NIS	**50 to < 100 NIS**	**100 to < 200 NIS**	**Above 200 NIS**	**Total**
Monthly Income	**Less than 400 NIS**						
		% within Income	53.2%	32.4%	7.2%	7.2%	100.0%
	400 NIS to less than 1000 NIS						
		% within Income	28.0%	40.0%	19.0%	13.0%	100.0%
	1000 NIS to less than 2000	% within Income	21.6%	29.3%	29.9%	19.2%	100.0%
	2000 NIS to less than 4000 NIS	% within Income	11.1%	29.4%	33.3%	26.1%	100.0%
	Above 4000 NIS	% within Income	8.8%	14.0%	22.8%	54.4%	100.0%
Total		**% within Income**	**24.7%**	**30.3%**	**24.0%**	**21.1%**	**100.0%**

Table (5.37): Chi-Square test for relationship between monthly income and monthly expenditure

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	130.725(a)	12	0.000
Likelihood Ratio	126.366	12	0.000
Linear-by-Linear Association	101.975	1	0.000
N of Valid Cases	588		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 12.02.			

From Chi-Square results in table 5.37 above, since sig. = 0.000 which is smaller than α = 0.01, then there exists a significant relationship between monthly income and monthly expenditure. Keeping in mind that the percentage of respondents who consider the Mobile as a necessity was 86.7 % . This means that although when the level of monthly income is low, the individual tries to cope with this situation and fulfill his/her believe of necessity even with less or minimum expenditure.

As time passes and the period of using mobile increases, the percentage of respondents who believe that Mobile is a necessity increases. Table 5.38 below shows that the percentage of respondents who are using mobile since 3 to 6 years period of time and believe in it as a necessity are 33.7% , while those of longer period of using mobile above six years and believe in it as necessity are 41% .

Table (5.38) : Cross tabulation between period of using mobile and necessity

Necessity * Period Cross tabulation							
			Period of Usage				
			< 1 year	**1 to < 3 years**	**3 to 6 years**	**> 6 years**	Total
Necessity	**Necessity**	Count	30	106	181	220	537
		% within Necessity	5.6%	19.7%	33.7%	41.0%	100.0%
	Luxury	Count	7	26	21	17	71
		% within Necessity	9.9%	36.6%	29.6%	23.9%	100.0%
Total		Count	37	132	202	237	608
		% within Necessity	6.1%	21.7%	33.2%	39.0%	100.0%

Table (5.39): Chi-Square test for relationship between period of using mobile and necessity

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.096(a)	3	0.002
Likelihood Ratio	14.278	3	0.003
Linear-by-Linear Association	13.308	1	0.000
N of Valid Cases	608		
a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 4.32.			

From Chi-Square results in above table 5.39, since sig. = 0.002 which is smaller than α = 0.01, then there exists a significant relationship between the period of using mobile and the necessity of it. This explains that even with low income and consequently low expenditure, the mobile users' diffusion continues without being affected by economic situation represented by GDP per capita.

5.7.2 H2 : More Fixed phone lines, increases the growth rate of mobile diffusion

It was clear from both scenarios of our regression model that Fixed phone lines "FIX" positively correlates with mobile growth since it has a positive coefficient value. It is also seen from SAS output in Table 5.2 that "FIX" has sig = 0.0015 for Scenario 1 , which means that there is a significant relationship between mobile users "CEL" and Fixed phone lines "FIX". Similarly for Model Scenario 2, SAS output in Table 5.9 showed that "FIX" has sig = 0.0013 , which means that there is a significant relationship between "ratio" of mobile users and Fixed phone lines "FIX".

Over all the effect of "FIX" variable on the mobile users in Model Scenario 1 is about 9.64% and similarly for Model Scenario 2, is about 7.01% as shown in Table 5.2 and Table 5.9 respectively.

This positive effect is also supported by questionnaire analysis. It is found that 44.5% of respondents prefer to use both types of communications, Mobile as well as Fixed phone line. Another 13.9% prefer Fixed phone line Only for their communications. Meanwhile 41% prefer

Mobile only as a communication tool. These preferences may imply that Mobile and Fixed phones are complements. Hence more fixed lines, the greater the growth of Mobile . This fact is statistically proven in both model scenarios since the coefficient of "FIX" variable is getting a positive sign.

Another indication from questionnaire analysis can be depicted to say that Mobile and Fixed phone lines are still complements. This is shown by cross tabulation between period of using mobile and communication preferences as shown in table 5.40 on the next page.

Table (5.40) : Cross tabulation between period of using mobile and communication preferences

Cross tabulation between Communication Preferences and Period Of Using Mobile							
			Period of Using Mobile				
			< 1 Year	1 to < 3 Years	3 -6 Years	Above 6 Years	Total
Communication	Mobile	Count	10	61	77	105	253
		% within Communication	4.0%	24.1%	30.4%	41.5%	100.0%
	Fixed	Count	11	18	19	26	74
		% within Communication	14.9%	24.3%	25.7%	35.1%	100.0%
	Both (Mobile+Fixed)	Count	16	53	105	106	280
		% within Communication	5.7%	18.9%	37.5%	37.9%	100.0%
Total		Count	37	132	201	237	607
		% within Communication	6.1%	21.7%	33.1%	39.0%	100.0%

Table (5.41) : Chi-Square test for relation between period of using mobile and communication preferences.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.401[a]	6	.008
Likelihood Ratio	15.046	6	.020
Linear-by-Linear Association	.042	1	.837
N of Valid Cases	607		

a. 1 cells (8.3%) have expected count less than 5. The minimum expected count is 4.51.

From Chi-Square results in previous table 5.41, since sig. = 0.008 which is smaller than α = 0.01, then there is exist a significant relationship between the period of using mobile and the communication preferences.

As we see from Table 5.41 , the new mobile users with less than one year period and prefer Fixed phone line are 14.9% , while only 4% prefer Mobile phone. As the period of using mobile increases, we notice that the believe of preferences changes towards mobile.

5.7.3 H3: Digitalization, correlates positively with the relative growth rate of mobile users

Digital systems are opposite to Analogue systems as technology changes from old analogue systems of limited services and resources to new digital systems of wide range of services and resources.

From Model scenario1, the variable "DIG1" negatively correlates with mobile growth , which in contrast implies that Digitalization positively correlates with mobile growth. SAS output in Table 5.2 shows that "DIG1" has sig = 0.0157 , which confirms a significant relationship with mobile users "CEL".

Similarly, from Model Scenario 2, the variable "DIG1" negatively correlates with "ratio" , which in contrast implies that Digitalization positively correlates with it . SAS output in Table 5.9 shows that "DIG1" has sig = 0.0201, which confirms significant relationship with "ratio" of mobile users.

As shown in SAS output Table 5.2 for Model Scenario 1, 11.8% more of the variability in mobile users "CEL" is explained by Digitalization "DIG1" . Similarly, for Model Scenario 2, 7.61% more of the variability in "ratio" of mobile users is explained by Digitalization "DIG1" as shown in Table 5.9.

5.7.4 H4: Presence of competition correlates positively with the relative growth rate

It is proved by both model scenarios that Competition "CMP" clearly correlates positively with the growth of mobile users since it has a positive coefficient value. From Model Scenario1, it is shown in SAS output Table 5.2 that "CMP" has sig = 0.0002, which means that there is a significant relationship between mobile users "CEL" and competition "CMP".
Similarly, for Model Scenario 2 ,it is also shown in SAS output Table 5.9 that "CMP" has sig < 0.0001 , which means that there is a significant relationship between "ratio" of mobile users and competition "CMP".

As shown in SAS output Table 5.2 for Model Scenario 1, 74.22% more of the variability in mobile users "CEL" is explained by competition "CMP" . Similarly, for Model Scenario 2, 82.41% more of the variability in "ratio" of mobile users is explained by competition "CMP" as shown in Table 5.9.

This fact is also supported by questionnaire analysis. As shown in Table 5.25 , there is a majority of 85.1% of overall respondents agree with competition factors listed their to choose or switch to other network operator.

Moreover, from cross tabulation of Mobile service provider and Location of residence in Table 5.42 , we can notice that 12.3% of respondents living in WB having both Jawwal and Israeli cellular mobiles , while in Gaza region, only 4% of respondents having Israeli cellular besides Jawwal mobile. This implies that the presence of competition has a appositive effect on the growth of mobile diffusion.

Table (5.42): Cross tabulation of Mobile service provider and Location of residence

Service Provider Vs. Location of Residence (WBG) Cross tabulation							
			Service Provider				
			Jawwal Only	Israeli Cellular	Jawwal+Israeli Cellular	Don't Have	Total
WBG	Gaza	Count	317	28	15	14	374
		% within WBG	84.8%	7.5%	4.0%	3.7%	100.0%
	West Bank	Count	183	30	32	15	260
		% within WBG	70.4%	11.5%	12.3%	5.8%	100.0%
Total		Count	500	58	47	29	634
		% within WBG	78.9%	9.1%	7.4%	4.6%	100.0%

Table (5.43): Chi-Square test for relationship between service provider and Location of residence

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.390(a)	3	0.000
Likelihood Ratio	22.138	3	0.000
Linear-by-Linear Association	16.631	1	0.000
N of Valid Cases	634		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.89.			

From Chi-Square results in above table 5.43, since sig. = 0.000 which is smaller than α = 0.01, then there exists a significant relationship between mobile service provider and Location of residence.

5.8 Implications for emerging 3G technology

The 3G technology differs from exiting GSM technology in its broadband and high capacity which is a platform for all new advanced services and applications such as multimedia, high speed Internet, email and video calls.

The growth of 3G networks around the world is still in initial phase. One of the obstacles for rapid growth is the cost of network infrastructure as well as the handset relatively high cost. But luckily the effect of those obstacles is gradually diminishing which may lead for continuous diffusion of this emerging technology.

For the Palestinian market, the 3G technology is not introduced yet. But from questionnaire analysis we notice a considerable percentage of respondents reaches to 36.5% who agree with 3G services as shown in multiple response of Appendix (H.)

5.8.1 The 3G service demand and Age

It was noticed from cross tabulation between 3G services and Age that younger generations are more interested in these 3G services. Keeping in mind that 45% of the Palestinian population is under 14 years (PBCS, 2007), in other words 52.3% is under 18 years old (PBCS,2006). This proves youthful paelstinian people, which imply that the future demand for the 3G services is promising even though the economic situation is not encouraging.

As seen from Table 5.44, there is a majority of 55.5% of Age less than 18 years , agree with 3G services, while in Age between 18 – 25 years, 36.2% agree with it. In the Age of 26-40 years, 36.8% agree with 3G services.

Table (5.44): Cross tabulation between the interest of 3G services and Age of respondents

3G Vs. Age Cross Tabulation								
			3G Services					Total
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
Age	< 18 years	Count	4	11	17	24	16	72
		% within Age	5.6%	15.3%	23.6%	33.3%	22.2%	100.0%
	18 - 25 years	Count	96	222	187	142	144	791
		% within Age	12.1%	28.1%	23.6%	18.0%	18.2%	100.0%
	26 - 40 years	Count	137	186	167	131	154	775
		% within Age	17.7%	24.0%	21.5%	16.9%	19.9%	100.0%
	41 - 50 years	Count	43	42	37	17	36	175
		% within Age	24.6%	24.0%	21.1%	9.7%	20.6%	100.0%
	Above 51 years	Count	18	22	9	10	14	73
		% within Age	24.7%	30.1%	12.3%	13.7%	19.2%	100.0%
Total		Count	298	483	417	324	364	1,886
		% within Age	15.8%	25.6%	22.1%	17.2%	19.3%	100.0%

Table (5.45): Chi-Square test for relationship between the 3G services and Age

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	54.567(a)	16	0.000
Likelihood Ratio	54.665	16	0.000
Linear-by-Linear Association	12.813	1	0.000
N of Valid Cases	1,886		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.38.			

From Chi-Square results in previous table 5.45, since sig. = 0.000 which is smaller than α = 0.01, then there is exist a significant relationship between the interest of 3G services and Age of respondents.

5.8.2 The 3G service demand and Period of using mobile

From Table 5.46 below and cross tabulation between 3G services and period of using mobile, we notice that the new mobile users are the most interesting to demand for 3G services. That was clearly depicted from the respondents' percentage of 42.7% who are using mobile services since less than one year, and interested in 3G services.

This implies that the interest for 3G services has started to increase since the last year and it is expected to be the interest of the majority of new subscribers in the next year. Hence we expect introducing 3G services by the end of 2008 unless there are external obstacles due to political situation and difficulties in achieving the required frequencies of 3G systems. These obstacles may delay the introduction of 3G to the next few years. It is worth to note that entrance of new service provider into the Palestinian market will implicitly implies that 3G services will be introduced in the first year of entrance. This conclusion is due to the fact that new competitor will have to go for 3G technology to guarantee a good position in the competitive market.

Table (5.46): Cross tabulation between 3G services and period of using mobile

3G Vs. Period Cross tabulation								
			3G Service					
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Period	< 1 year	Count	22	22	19	25	22	110
		% within Period	20.0%	20.0%	17.3%	22.7%	20.0%	100.0%
	1 to < 3 years	Count	59	112	80	55	88	394
		% within Period	15.0%	28.4%	20.3%	14.0%	22.3%	100.0%
	3 - 6 years	Count	113	137	132	112	108	602
		% within Period	18.8%	22.8%	21.9%	18.6%	17.9%	100.0%
	> 6 years	Count	82	185	172	122	142	703
		% within Period	11.7%	26.3%	24.5%	17.4%	20.2%	100.0%
Total		Count	276	456	403	314	360	1,809
		% within Period	15.3%	25.2%	22.3%	17.4%	19.9%	100.0%

Table (5.47): Chi-Square test for relationship between 3G services and period of using mobile

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	27.867(a)	12	0.006
Likelihood Ratio	28.074	12	0.005
Linear-by-Linear Association	0.845	1	0.358
N of Valid Cases	1,809		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 16.78.			

From Chi-Square results in above table 5.47, since sig.=0.006 which is smaller than α = 0.01, then there is exist a significant relationship between the interest in 3G services and period of using mobile.

5.9 Mobile Diffusion and Models fit

As mentioned earlier in literature review of chapter one, the mobile diffusion spread over time and typically follows a sigmoid or S-shaped curve.

Here we use the historical data of cumulative mobile users for the last 13 years starting from 1994 till the end of 2006 to fit into different four models chosen carefully to represent the data. We use SPSS and its built-in four following models to test and fit the data. Table 5.48 below summarizes the result of fitting data into models, Linear, Exponential, S-curve and Logistic.

Table (5.48): Comparison of R^2 values among different models.

	Linear	**Exponential**	**S-curve**	**Logistic**
R^2	0.919	0.934	0.935	0.987
Adj- R^2	0.912	0.928	0.929	0.986

Generally speaking, all the chosen models above can fit the data well. It is clear that S-curve and Exponential models are mostly similar in accuracy of fit. Meanwhile Logistic Model has the best fit of data since it has the highest value of R^2. The figures on the next page show the shape and data fit for each of these four models.

Hence it is recommended for future research to study the diffusion of mobile in more depth by using Logistic fit and extrapolating the curve to forecast the future. This will explore more valuable information about the diffusion pattern and its characteristics, such as the inflection point and critical mass.

Figure 5.7 Linear Model Fit

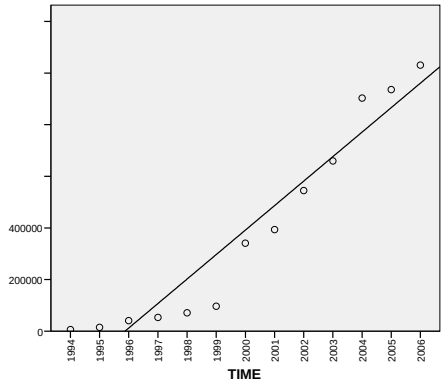


Figure 5.8 Exponential Model Fit

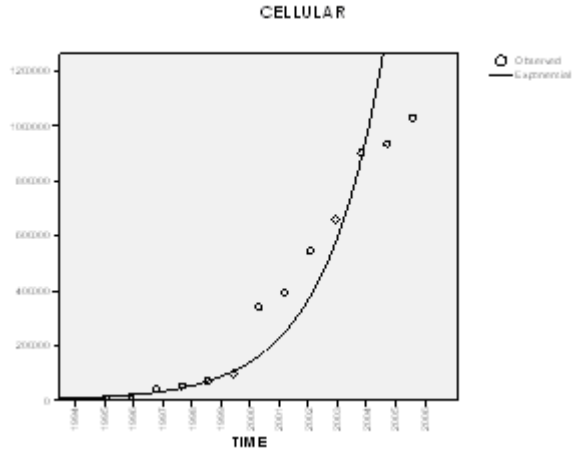


Figure 5.9 . S-curve Model Fit

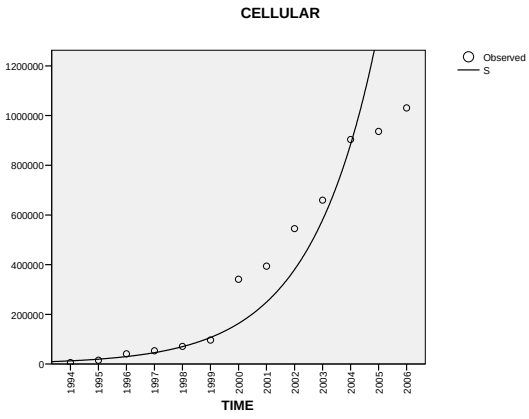
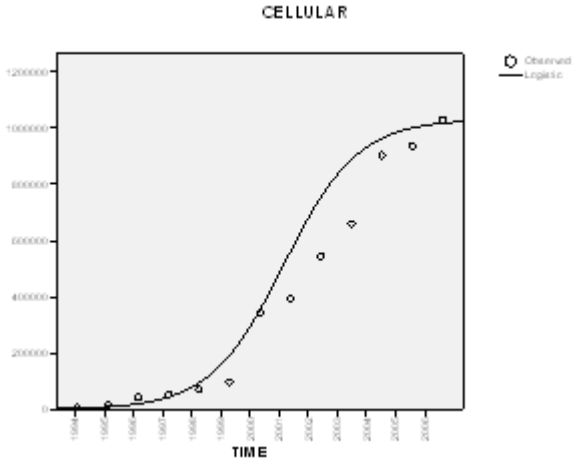


Figure 5.10 . Logistic Model Fit



Chapter Six

Conclusions & Recommendations

6.1 Introduction

In this last chapter, we sum up our work and outline conclusions on the field of this research. These conclusions are particular to the Palestinian market since the scope of the study is limited to mobile diffusion in Palestine, and to developing a forecasting model customized to it. Nevertheless, there are some common results and conclusions which can be generalized for mobile telecommunications diffusion among countries.

At the end of this chapter, some recommendations will be presented that can be of interest to various concerned groups and to researchers for a future work in this field.

6.2 Conclusions

In the following subsections we discuss in detail the primary set of conclusions of our research. However, there is also an additional finding which we believe is important to be mentioned at this point.

We found in this research that the mobile diffusion in the Palestinian market follows the general pattern of the innovation diffusion theory which suggests an S-shaped curve for the path of an innovation's diffusion. This is consistent with the findings of Jang et.al (2005). They found that the pattern of mobile diffusion of all the samples of 30 countries is generally characterized by an S-shaped curve. Nevertheless, significant differences exist in the spread of the S curve due to differences in countries' characteristics.

The main conclusions of this study are summarized in the following subsections.

6.2.1 GDP per capita and effect on mobile diffusion

GDP is a measure of the economic situation for a specific nation. In our case the GDP per capita has no significant effect on mobile diffusion. This result was clear from both model scenarios which we developed to explore the effect of different chosen variables on mobile diffusion.

This conclusion is consistent with the study of Jang et.al (2005) which identified the key determinants of mobile diffusion rates for 30 countries, and found that GDP per capita has no significant effect on mobile diffusion. Moreover, the study of Gruber (2001) which covered mobile diffusion in European Union countries, found that the parameter estimate of GDP was not significant. Meanwhile, the study of Frank (2002) which analyzed the effect of the economic situation on mobile diffusion in Finland, found that GDP has a positive effect on the diffusion.

Nevertheless, the diffusion process in the Palestinian market continues due to other determinants which may overcome the weak economic situation. From Appendix (G) we notice that there is a majority of 55% of overall income levels expend less than 100 NIS per month on mobile. Keeping in mind that 86.7% of respondents consider the mobile phone as a necessity. This means that although the level of income is low, the individual tries to cope with this situation and fulfill his sense of necessity even with low or minimum expenditure on mobile phone.

6.2.2 Competition as a factor accelerates mobile diffusion

A mobile telecommunication market is said to be competitive if there is more than one service provider operating in that market. In our case, while the Palestinian operator Jawwal is the only and dedicated legal mobile operator in the Palestinian market, there is a number of Israeli service providers who have subscribers in the Palestinian market. We considered all these Israeli service providers as one operator competing against Jawwal.

In this study, we found that the competition effect was the most significant in both model scenarios developed in chapter 5. This conclusion is consistent with the findings of Jang et.al (2005) in their study of all the samples of 30 countries which supports the hypothesis that competition accelerates the innovation diffusion. Moreover, they include the number of new service providers in the model as a proxy for competition, and noticed that for Australia, year 2000, when the number of firms increased from three to six, the penetration rate jumped noticeably from the previous year. Also, it is consistent with findings of Gruber's study (2001) which covered the mobile diffusion in European Union countries. In that study it was noticed that the impact of introducing competition was significant during both the analogue and the digital periods, though the effect was smaller than the technology effect.

The model scenario 1 shows that 74.22% more of the variability in mobile users is explained by competition. Similarly, for model scenario 2, 82.41% more of the variability in "ratio" of mobile users is explained by competition.

It is noteworthy that there is a majority of 85.1% of overall respondents who agree that competition factors influence their decision to choose or switch to another network operator.

Moreover, from cross tabulation of "Mobile service provider" and "Location of residence" in Appendix (G) , we can notice that 12.3% of respondents living in WB have both Jawwal and Israeli cellular mobile subscriptions, while in the Gaza region, only 4% of respondents have Israeli cellular subscriptions besides Jawwal. Keeping in mind that the presence of Israel cellular coverage is more dominant in West Bank than Gaza Strip due to scattered Israel settlements their while in Gaza Strip it is free of settlements since the withdrawal of September 2005. This implies that the presence of competition has a positive effect on the growth of mobile diffusion by acquiring multiple subscriptions for some mobile users.

6.2.3 Digitalization has considerable impact on mobile diffusion

Mobile telecommunication systems changed from old analogue systems of limited services and resources to new digital systems of a wide range of services and resources. We find that this transition from analogue to digital technology, which occurred in the year 1999, had a considerable impact on the diffusion of mobile users. This conclusion is consistent with findings in the study of Gruber (2001). Also the study of Jang et.al (2005) underlines the importance of the switch to digital technology.

As shown in Model Scenario 1, 11.8% more of the variability in mobile users is explained by the digitalization factor. Similarly, for model scenario 2, 7.61% more of the variability in the "ratio" of mobile users is explained by the digitalization factor.

6.2.4 Fixed phone lines is in complementary stage with mobile users

It was clear from both scenarios of our regression model that the fixed phone lines factor positively correlates with mobile growth since it has a positive coefficient value. The overall effect of the fixed phone lines variable on the number of mobile users in model scenario 1 is about 9.64%, and for model scenario 2 is about 7.01%.

This positive effect is also supported by questionnaire analysis. It is found that 44.5% of respondents prefer to use both types of communications; mobile as well as fixed phone line. Another 13.9% prefer fixed phone lines *only*. Meanwhile 41% prefer mobile phones *only* as their communication tool. These preferences may imply that mobile and fixed phones are complementary. Hence the more fixed lines there is, the greater the growth of mobile. This fact is statistically proven in both of our model scenarios since the coefficient of the "FIX" variable has a positive sign.

This conclusion is valid for the Palestinian market at this stage. In the future we may notice a substitution stage where mobile phones replace the fixed phone lines. This stage has already occurred for most of the leading countries in telecommunication diffusion.

According to Gruber (2001), mobile telecommunications were conceived in the early years as a complementary service to fixed telecommunications, mainly for business people and wealthy persons. Guber indicates that as mobile telecommunications become a widely spread service and its tariff becomes comparable to that of fixed lines, substitution effect may become predominant. Also, according to Jang et.al (2005), since 1988, the complementarity has transformed itself into substitutability in OECD countries.

6.2.5 Implications for 3G emerging technology

For the Palestinian market, although 3G technology is not introduced yet, from questionnaire analysis we notice a considerable percentage of respondents reaching 36.5% who agree with 3G services and applications.

It was clear that younger generations are more interested in these 3G services which imply that future demand for 3G services is promising even though the economic situation is not encouraging. The interest for 3G services and applications has started to increase since last year and it is expected to be the interest of the majority of new subscribers in the next year. Hence we expect introducing 3G services by the end of 2008 unless there are external having to do with the political situation such as difficulties in achieving the required frequencies of 3G systems. These obstacles may delay the introduction of 3G for a few years. It is worth to note that entrance of new service provider into the Palestinian market implicitly implies that 3G services will be introduced in the first year of entrance. This conclusion is based on the fact that new competitor will have to go for 3G technology to guarantee good position in competitive market.

6.3 Recommendations

Here we sum up our recommendations to three main groups: service providers, policy makers, and researchers. The main goal of these recommendations is to strengthen the presence of telecom market in Palestine, improve its diffusion and get the best of it.

6.3.1 Recommendations for service providers and strategy planners

In such a dynamic market, the state of the art technology offerings and utility applications customized to the market segments play a vital role for success and sustainability. Here are some recommendations to service providers and strategy planners which may help in visioning a smooth future path for mobile diffusion:

- Pay considerable attention to application content to suit the targeted segments. For example, video call service is expected to be the driver force for 3G service usage.
- Handset can be used as a tool for churn prevention as well as for more mobile diffusion.
- Improve segmentation and offer targeted postpaid services and introduce attractive value added services.
- More attention for customer loyalty to avoid churn, customer acquisition strategies to attract high spending customers and adapting customer relation management.

6.3.2 Recommendations for Policy makers and regulatory bodies

- Maintain detailed records for historical data of ICT diffusion and its applications on regular basis with centralized and computerized archiving system to be easily accessible for interested researchers and decision makers.
- Conduct surveys on national level for regular updates of ICT data.
- Complete liberalization of the field of telecommunications with clear and state of the art regulatory rules and organizational bodies.
- Monitor the illegal activities of neighboring service providers and set a series of actions and strategies to minimize its impacts on the Palestinian market. The Israeli operators covering and operating in Palestinian areas is an illegal action and should be taken into account in any future negotiations.
- Palestinians have the lawful right to have control on their own spectrum and frequencies. This issue should be raised to and settled in international bodies until Israelis recognize this right.

6.3.3 Recommendations for future research

- It is recommended for future research to study the diffusion of mobile in more depth by exploring more valuable information about the diffusion pattern and its characteristics, such as inflection point and critical mass. Future research can utilize other tools such as logistic fit and extrapolating the curve to forecast the future.
- Conduct an empirical study for mobile diffusion in neighboring countries and explore the common characteristics that affect the mobile diffusion path.
- Study of the dynamics of usage intensity of mobile over the diffusion curve.

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Appendix (A) SAS Code for Regression model Using Forecast by "CEL" – Scenario 1

```
DATA mobile;
       N                  gdp         g    cm              g1   dig2 @@;
DATALINES;
   6000.00   58459.00      1126.00     .00     .00       1.00      .00   .00
  15000.00   59850.00      1234.00     .00     .00       1.00      .00   .00
  41000.00   61241.00      1241.00     .00     .00       1.00      .00   .00
  53000.00   110893.00     1313.00     .00     .00       1.00      .00   .00
  71000.00   167271.00     1346.00     .00     .00       1.00      .00   .00
  96538.00   222198.00     1374.00    1.00     .00        .00     1.00   .00
 341000.00   272212.00     1307.00    1.00    1.00        .00     1.00   .00
 393791.00   292022.00     1171.00    1.00    1.00        .00     1.00   .00
 544997.00   301579.00     1035.00    1.00    1.00        .00     1.00   .00
 659418.00   252038.00     1128.00    2.00    1.00        .00      .00    1.00
 903405.00   290010.00     1134.00    2.00    1.00        .00      .00    1.00
 936292.00   348968.00     1129.00    2.00    1.00        .00      .00    1.00
1030705.00   341330.00     1141.00    2.00    1.00        .00      .00    1.00
;
run;

proc print data=mobile; run;

proc reg data = mobile;
model cell = fix gdp cmp dig0 dig1 /clb selection=stepwise slentry=0.05
                                   slstay=0.15  vif alpha=.05;
run;

proc corr data=mobile;
var cell fix cmp dig1;
run;

data Forecast1;
input cell cmp dig1 fix;
cards;
. 1 0 399074
. 1 0 425556
. 1 0 452038
. 1 0 478521
. 1 0 505003
. 1 0 531485
. 1 0 557967
. 1 0 584450
. 1 0 610932
. 1 0 637414
;

data Forecast;
set mobile Forecast1;
run;
proc print data=Forecast; run;
proc reg data=Forecast;
model cell = cmp dig1 fix /p  cli clb vif alpha=.05;
run;
```

Appendix (B)

SAS Code for Regression model Using Forecast by "RATIO" – Scenario 2

Ratio

```
DATA mobile;
      INPUT cell pot fix gdp popt_star dig cmp dig0 dig1 dig2 ratio @@;
DATALINES;
   6000 1130245 58459.00 1126.00 1136245     .00     .00    1.00     .00     .00  .00528
  15000 1297994 59850.00 1234.00 1312994     .00     .00    1.00     .00     .00  .01142
  41000 1461065 61241.00 1241.00 1502065     .00     .00    1.00     .00     .00  .02730
  53000 1651161 110893.0 1313.00 1704161     .00     .00    1.00     .00     .00  .03110
  71000 1852074 167271.0 1346.00 1923074     .00     .00    1.00     .00     .00  .03692
  96538 2309669 222198.0 1374.00 2406207    1.00     .00     .00    1.00     .00  .04012
 341000 2464318 272212.0 1307.00 2805318    1.00    1.00     .00    1.00     .00  .12155
 393791 2616004 292022.0 1171.00 3009795    1.00    1.00     .00    1.00     .00  .13084
 544997 2641202 301579.0 1035.00 3186199    1.00    1.00     .00    1.00     .00  .17105
 659418 2685998 252038.0 1128.00 3345416    2.00    1.00     .00     .00    1.00  .19711
 903405 2703048 290010.0 1134.00 3606453    2.00    1.00     .00     .00    1.00  .25050
 936292 2882711 348968.0 1129.00 3819003    2.00    1.00     .00     .00    1.00  .24517
1030705 3051507 341330.0 1141.00 4082212    2.00    1.00     .00     .00    1.00  .25249

;
run;


proc reg data = mobile;
model ratio = fix gdp cmp dig0 dig1 /clb selection=stepwise
slentry=0.05
                                  slstay=0.15  vif alpha=.05;
run;

data Forecast1;
input ratio cmp dig1 fix;
cards;
. 1 0 399074
. 1 0 425556
. 1 0 452038
. 1 0 478521
. 1 0 505003
. 1 0 531485
. 1 0 557967
. 1 0 584450
. 1 0 610932
. 1 0 637414
;

data Forecast;
set mobile Forecast1;
run;

model ratio = cmp dig1 fix /p  cli clb vif alpha=.05;
run;
```

Appendix (C) : Historical Raw Data

Obs.	Year	CEL	FIX	GDP	DIG	CMP	POPt	COVt %	POTt
1	**1994**	6000	58459	1126	0	No	2524989	0.45	1136245
2	**1995**	15000	59850	1234	0	No	2625988	0.5	1312994
3	**1996**	41000	61241	1241	0	No	2731028	0.55	1502065
4	**1997**	53000	110893	1313	0	No	2840269	0.6	1704161
5	**1998**	71000	167271	1346	0	No	2958576	0.65	1923074
6	**1999**	96538	222198	1374	1	No	3084881	0.78	2406207
7	**2000**	341000	272212	1307	1	Yes	3224504	0.87	2805318
8	**2001**	393791	292022	1171	1	Yes	3381792	0.89	3009795
9	**2002**	544997	301579	1035	1	Yes	3559999	0.895	3186199
10	**2003**	659418	252038	1128	2	Yes	3737895	0.895	3345416
11	**2004**	903405	290010	1134	2	Yes	3920058	0.92	3606453
12	**2005**	936292	348968	1129	2	Yes	4106455	0.93	3819003
13	**2006**	1030705	341330	1141	2	Yes	4297065	0.95	4082212

Source: adjusted by researcher from variety of references and official resources.

CEL : Total number of cellular mobile users in Palestinian Market . This includes subscribers belonging to Jawwal in addition to other Palestinian subscribers of competing Israeli operators serving in Palestinian market.

FIX : Total number of Fixed telephone lines working in Palestinian Market. This belongs to Paltel subscribers.

GDP : Its is the Gross Domestic Product (GDP) per Capita in US dollars.

DIG : It is an indication of network type availability .
Zero for Absence of Digital and 1 for Presence of Both Digital and Analog, and 2 for Digital presence Only.

CMP : It is an indicator for Competition in Palestinian Cellular Market.
'Yes' means competition exist and 'No' for absence of competition.

POPt : Palestinian Population in West Bank & Gaza at year t

COVt : Coverage Percentage of Cellular Networks at year t.

POTt : The population covered by cellular networks at year t. (POTt= COVt x POPt)

Note : Year 1999 was introductory year for Jawwal, so competition level will Be considered to start from year 2000.

C.1 : Future values for extrapolating model scenario 2

Year	Assumed "COV" %	"POP" Forecasted	"POT" Calculated
2007	0.96	4,491,723	4,312,054
2008	0.97	4,690,090	4,549,387
2009	0.97	4,891,902	4,745,145
2010	0.98	5,084,238	4,982,553
2011	0.98	5,293,646	5,187,773
2012	0.98	5,411,927	5,303,688
2013	0.99	5,571,654	5,515,937
2014	0.99	5,732,859	5,675,530
2015	0.99	5,895,280	5,836,327
2016	0.99	6,053,635	5,993,099

Where :

$$POT_{(t)} = COV_{(t)} * POP_{(t)}$$

Appendix (D) : Palestinian Population forecast in WBG (1997-2024)

جدول 4: عدد السكان المتوقع في الأراضي الفلسطينية حسب المنطقة (1997-2024)

	الأراضي الفلسطينية		الضفة الغربية		قطاع غزة	
	العدد	معدل النمو (%)	العدد	معدل النمو (%)	العدد	معدل النمو (%)
1997	2,840,269	4	1,622,717	3.8	1,017,552	4.3
1998	2,958,576	4.2	1,895,255	4.5	1,063,324	4.5
1999	3,084,881	4.3	1,972,284	4.1	1,112,597	4.6
2000	3,224,504	4.4	2,057,145	4.3	1,167,359	5
2001	3,381,792	3.3	2,152,501	4.6	1,229,351	5.3
2002	3,559,999	5.3	2,260,595	5	1,290,400	5
2003	3,737,895	5	2,367,550	4.7	1,370,345	6.2
2004	3,920,058	4.9	2,476,321	4.6	1,443,737	5.3
2005	4,106,455	4.8	2,588,631	4.5	1,519,624	5.3
2006	4,297,065	4.6	2,699,011	4.3	1,595,054	5
2007	4,491,723	4.5	2,812,823	4.2	1,678,900	5.3
2008	4,690,090	4.4	2,926,261	4	1,761,829	5
2009	4,891,902	4.3	3,045,278	4.1	1,846,624	4.8
2010	5,084,238	3.9	3,155,628	3.6	1,928,812	4.5
2011	5,293,646	4	3,250,784	3	2,002,887	3.8
2012	5,411,927	2.2	3,338,297	2.7	2,073,630	3.5
2013	5,571,654	2.9	3,426,221	2.6	2,145,433	3.4
2014	5,732,859	2.9	3,514,519	2.6	2,216,340	3.3
2015	5,895,280	2.8	3,603,044	2.5	2,292,236	3.4
2016	6,053,635	2.7	3,691,642	2.5	2,356,904	2.8
2017	6,224,166	2.8	3,781,798	2.4	2,442,368	3.6
2018	6,394,694	2.7	3,876,724	2.5	2,517,990	3.1
2019	6,571,639	2.8	3,976,045	2.6	2,593,594	3
2020	6,754,952	2.8	4,065,935	2.2	2,659,017	2.5
2021	6,944,602	2.8	4,200,500	3.3	2,744,102	3.2
2022	7,135,333	2.7	4,317,528	2.8	2,818,805	2.7
2023	7,321,456	2.6	4,428,262	2.6	2,893,194	2.6
2024	7,495,103	2.4	4,527,877	2.2	2,997,226	3.6

المصدر: مسح السكان في الأراضي الفلسطينية (1997)، الجهاز المركزي للإحصاء الفلسطيني، رام الله، فلسطين

Appendix (E) : Mobile Diffusion and Models fit

E.1 Linear Model

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.959		.912	114540.863

The inde

ANO

	Squares	df	Mean Square	F	Sig.
Regressi		1	1. E+	124.891	.000
Residual			131		
Total	1.8E+012	12			

The inde E.

Coefficients

	U and ize Coefficients		S da ed Coefficients		
	B	Error			Sig.
	94883.577	8490.334	.959	11.175	.000
	-2E	0697		-11.152	.000

E.2 Exponential Model

ary

		uar	sti te
.96		.92	8

ANOVA

			an Square	F	Sig
	3		545	1 .349	.000
	34 8				

ndependen TIM

Coefficients

	Unstandardized Coefficients				
	B	Std. Error	Beta	t	Sig.
TIME	.423	.034	.966	12.464	.000
(Constant)	.000	.000			.

The dependent variable is ln(CELLULAR).

E.3 S-curve Model

Model Summary

R	R Square	Adjusted R Square	Std. E the Es
.967	.935	.9	. 5

he independen is TIM

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	32.570	1	32.570	157.149	.000
Residual	2.280	11	.207		
Total	34.850	12			

The independent variable is TIME.

Coefficients

	Unstandardized Coefficients		Coefficients		
	B	Std. Error	Beta	t	Sig.
1 / TIME	-1692111	134981.3	-.967	-12.536	.000
(Constant)	858.059	67.491		12.714	.000

The dependent variable is ln(CELLULAR).

E.4 Logistic Model

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.994	.987	.986	2

The independent variable is TIME.

ANOVA

	Sum Squar	df	Mean Square		Sig.
Regression	71.272	1	71.272	838.036	.000
Residual	.936	11	.085		
Total	72.208	12			

The independent variable is TIME.

Coefficients

	Coefficients		Coefficients		
	B	Std. Error	Beta	t	Sig.
TIME	.535	.012	.370	46.260	.000
(Constant)	INF	INF		Nan	1.000

The dependent variable is ln(1 / CELLULAR - 1 / 1100000.000).

Appendix (F) : Forecasted Figures of two scenarios Models

TIME	CELL	POP	FIX	GDP	POT	DIG	CMP	DIG_0	DIG_1	DIG_2	PRE_Cell	LICI_Cell	UICI_Cell	PRE_Ratio	LICI_Ratio	UICI_Ratio
1,994	6,000	2524989	58,459	1,126	1,136,245	0.00	0.00	1.00	0.00	0.00	-27,702	-263,543	208,140	0.00866	-0.04058	0.05791
1,995	15,000	2625988	59,850	1,234	1,312,994	0.00	0.00	1.00	0.00	0.00	-24,283	-259,676	211,109	0.00940	-0.03975	0.05855
1,996	41,000	2731028	61,241	1,241	1,502,065	0.00	0.00	1.00	0.00	0.00	-20,865	-255,821	214,090	0.01013	-0.03893	0.05919
1,997	53,000	2840269	110,893	1,313	1,704,161	0.00	0.00	1.00	0.00	0.00	101,153	-126,401	328,708	0.03639	-0.01112	0.08391
1,998	71,000	2958576	167,271	1,346	1,923,074	0.00	0.00	1.00	0.00	0.00	239,700	684	478,717	0.06621	0.01630	0.11612
1,999	96,538	3084881	222,198	1,374	2,406,207	1.00	0.00	0.00	1.00	0.00	14,535	-257,909	286,978	0.02135	-0.03554	0.07823
2,000	341,000	3224504	272,212	1,307	2,805,318	1.00	1.00	0.00	1.00	0.00	413,647	170,885	656,408	0.13874	0.08804	0.18943
2,001	393,791	3381792	292,022	1,171	3,009,795	1.00	1.00	0.00	1.00	0.00	462,329	223,963	700,695	0.14921	0.09944	0.19898
2,002	544,997	3559999	301,579	1,035	3,186,199	1.00	1.00	0.00	1.00	0.00	485,815	248,683	722,948	0.15427	0.10475	0.20378
2,003	659,418	3737895	252,038	1,128	3,345,416	2.00	1.00	0.00	0.00	1.00	724,217	489,042	959,392	0.20198	0.15287	0.25109
2,004	903,405	3920058	290,010	1,134	3,606,453	2.00	1.00	0.00	0.00	1.00	817,532	586,386	1,048,678	0.22206	0.17380	0.27033
2,005	936,292	4106455	348,968	1,129	3,819,003	2.00	1.00	0.00	0.00	1.00	962,419	718,822	1,206,016	0.25324	0.20238	0.30411
2,006	1,030,705	4297065	341,330	1,141	4,082,212	2.00	1.00	0.00	0.00	1.00	943,649	702,883	1,184,415	0.24920	0.19893	0.29948
		4,491,723	399,074		4,312,054		1.00		0.00		1,085,553	815,729	1,355,377	0.27974	0.22340	0.33608
		4,690,090	425,556		4,549,387		1.00		0.00		1,150,632	862,439	1,438,824	0.29375	0.23357	0.35393
		4,891,902	452,038		4,745,145		1.00		0.00		1,215,710	906,726	1,524,695	0.30776	0.24324	0.37227
		5,084,238	478,521		4,982,553		1.00		0.00		1,280,792	949,046	1,612,538	0.32176	0.25249	0.39103
		5,293,646	505,003		5,187,773		1.00		0.00		1,345,870	989,772	1,701,968	0.33577	0.26141	0.41012
		5,411,927	531,485		5,303,688		1.00		0.00		1,410,949	1,029,213	1,792,685	0.34977	0.27006	0.42948
		5,571,654	557,967		5,515,937		1.00		0.00		1,476,028	1,067,608	1,884,447	0.36378	0.27850	0.44906
		5,732,859	584,450		5,675,530		1.00		0.00		1,541,109	1,105,153	1,977,064	0.37779	0.28676	0.46882
		5,895,280	610,932		5,836,327		1.00		0.00		1,606,187	1,141,995	2,070,380	0.39179	0.29487	0.48872
		6,053,635	637,414		5,993,099		1.00		0.00		1,671,266	1,178,256	2,164,276	0.40580	0.30285	0.50874

Appendix (G) : G.1 : Income Vs. Expenditure Cross tabulation

Income Vs. Expenditure Cross tabulation							
			Expenditure				
			< 50 NIS	50 to < 100 NIS	100 to < 200 NIS	Above 200 NIS	Total
Income	Less than 400 NIS	Count	59	36	8	8	111
		% within Income	53.2%	32.4%	7.2%	7.2%	100.0%
	400 NIS to less than 1000 NIS	Count	28	40	19	13	100
		% within Income	28.0%	40.0%	19.0%	13.0%	100.0%
	1000 NIS to less than 2000	Count	36	49	50	32	167
		% within Income	21.6%	29.3%	29.9%	19.2%	100.0%
	2000 NIS to less than 4000 NIS	Count	17	45	51	40	153
		% within Income	11.1%	29.4%	33.3%	26.1%	100.0%
	Above 4000 NIS	Count	5	8	13	31	57
		% within Income	8.8%	14.0%	22.8%	54.4%	100.0%
Total		**Count**	**145**	**178**	**141**	**124**	**588**
		% within Income	**24.7%**	**30.3%**	**24.0%**	**21.1%**	**100.0%**

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	130.725(a)	12	0.000
Likelihood Ratio	126.366	12	0.000
Linear-by-Linear Association	101.975	1	0.000
N of Valid Cases	588		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 12.02.			

G.2 Necessity Vs. Period Cross tabulation

Necessity Vs. Period Cross tabulation							
			Period of Usage				
			< 1 year	1 to < 3 years	3 to 6 years	> 6 years	Total
Necessity	Necessity	Count	30	106	181	220	537
		% within Necessity	5.6%	19.7%	33.7%	41.0%	100.0%
	Luxury	Count	7	26	21	17	71
		% within Necessity	9.9%	36.6%	29.6%	23.9%	100.0%
Total		Count	37	132	202	237	608
		% within Necessity	6.1%	21.7%	33.2%	39.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.096(a)	3	0.002
Likelihood Ratio	14.278	3	0.003
Linear-by-Linear Association	13.308	1	0.000
N of Valid Cases	608		
a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 4.32.			

G.3 Service Provider Vs. Location of Residence (WBG) Cross tabulation

Service Provider Vs. Location of Residence (WBG) Cross tabulation							
			Service Provider				
			Jawwal Only	Israeli Cellular	Jawwal+Israeli Cellular	Don't Have	Total
WBG	Gaza	Count	317	28	15	14	374
		% within WBG	84.8%	7.5%	4.0%	3.7%	100.0%
	West Bank	Count	183	30	32	15	260
		% within WBG	70.4%	11.5%	12.3%	5.8%	100.0%
Total		Count	500	58	47	29	634
		% within WBG	78.9%	9.1%	7.4%	4.6%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.390(a)	3	0.000
Likelihood Ratio	22.138	3	0.000
Linear-by-Linear Association	16.631	1	0.000
N of Valid Cases	634		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.89.			

G.4 : Age Vs. Service Provider Cross tabulation

Age Vs. Service Provider Cross tabulation							
			Service Provider				Total
			Jawwal Only	Israeli Cellular	Jawwal+Israeli Cellular	Don't have	
Age	< 18 years	Count	20	0	2	3	25
		% within Age	80.0%	0.0%	8.0%	12.0%	100.0%
	18 - 25 years	Count	217	23	15	10	265
		% within Age	81.9%	8.7%	5.7%	3.8%	100.0%
	26 - 40 years	Count	203	29	20	6	258
		% within Age	78.7%	11.2%	7.8%	2.3%	100.0%
	41 -50 years	Count	48	3	4	4	59
		% within Age	81.4%	5.1%	6.8%	6.8%	100.0%
	Above 51years	Count	11	2	6	6	25
		% within Age	44.0%	8.0%	24.0%	24.0%	100.0%
Total		Count	499	57	47	29	632
		% within Age	79.0%	9.0%	7.4%	4.6%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	46.776(a)	12	0.000
Likelihood Ratio	35.796	12	0.000
Linear-by-Linear Association	10.246	1	0.001
N of Valid Cases	632		
a. 8 cells (40.0%) have expected count less than 5. The minimum expected count is 1.15.			

G. 5 : Service Type Vs. Expenditure Cross tabulation

Service Type * Expenditure Cross tabulation							
			Expenditure				
			< 50 NIS	**50 to < 100 NIS**	**100 to < 200 NIS**	**Above 200 NIS**	Total
Service	Post Paid	Count	4	30	62	73	169
		% within Service	2.4%	17.8%	36.7%	43.2%	100.0%
	Prepaid	Count	148	142	56	14	360
		% within Service	41.1%	39.4%	15.6%	3.9%	100.0%
	Post+PrePaid	Count	5	12	26	36	79
		% within Service	6.3%	15.2%	32.9%	45.6%	100.0%
Total		Count	157	184	144	123	608
		% within Service	25.8%	30.3%	23.7%	20.2%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	246.517(a)	6	0.000
Likelihood Ratio	278.501	6	0.000
Linear-by-Linear Association	21.516	1	0.000
N of Valid Cases	608		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 15.98.			

Appendix (H) Cross Tabulation for 3G related phrases

H.1 : Frequencies of 3G

Extra Services like internet and e-mail			
		Frequency	Valid Percent
Valid	Strongly Disagree	95	15.0
	Disagree	165	26.1
	Neutral	135	21.3
	Agree	121	19.1
	Strongly Agree	117	18.5
	Total	633	100.0

Advanced services like TV Mobile			
		Frequency	Valid Percent
Valid	Strongly Disagree	106	16.8
	Disagree	182	28.9
	Neutral	143	22.7
	Agree	90	14.3
	Strongly Agree	109	17.3
	Total	630	100.0

Video Call service			
		Frequency	Valid Percent
Valid	Strongly Disagree	98	15.5
	Disagree	137	21.6
	Neutral	142	22.4
	Agree	114	18.0
	Strongly Agree	142	22.4
	Total	633	100.0

Multiple Response

3G Frequencies			
		Responses	
		N	Percent
3G (a)	Strongly Disagree	299	15.8%
	Disagree	484	25.5%
	Neutral	420	22.2%
	Agree	325	17.1%
	Strongly Agree	368	19.4%
Total		1,896	100.0%
a. Group			

H.2 : 3G * Age Cross Tabulation

3G * Age Cross Tabulation								
			3G Services					
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Age	< 18 years	Count	4	11	17	24	16	72
		% within Age	5.6%	15.3%	23.6%	33.3%	22.2%	100.0%
	18 - 25 years	Count	96	222	187	142	144	791
		% within Age	12.1%	28.1%	23.6%	18.0%	18.2%	100.0%
	26 - 40 years	Count	137	186	167	131	154	775
		% within Age	17.7%	24.0%	21.5%	16.9%	19.9%	100.0%
	41 - 50 years	Count	43	42	37	17	36	175
		% within Age	24.6%	24.0%	21.1%	9.7%	20.6%	100.0%
	Above 51 years	Count	18	22	9	10	14	73
		% within Age	24.7%	30.1%	12.3%	13.7%	19.2%	100.0%
Total		Count	298	483	417	324	364	1,886
		% within Age	15.8%	25.6%	22.1%	17.2%	19.3%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	54.567(a)	16	0.000
Likelihood Ratio	54.665	16	0.000
Linear-by-Linear Association	12.813	1	0.000
N of Valid Cases	1,886		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.38.			

H.3: 3G * Period Cross tabulation

3G * Period Cross tabulation								
			3G Service					
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Period	< 1 year	Count	22	22	19	25	22	110
		% within Period	20.0%	20.0%	17.3%	22.7%	20.0%	100.0%
	1 to < 3 years	Count	59	112	80	55	88	394
		% within Period	15.0%	28.4%	20.3%	14.0%	22.3%	100.0%
	3 - 6 years	Count	113	137	132	112	108	602
		% within Period	18.8%	22.8%	21.9%	18.6%	17.9%	100.0%
	> 6 years	Count	82	185	172	122	142	703
		% within Period	11.7%	26.3%	24.5%	17.4%	20.2%	100.0%
Total		Count	276	456	403	314	360	1,809
		% within Period	15.3%	25.2%	22.3%	17.4%	19.9%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	27.867(a)	12	0.006
Likelihood Ratio	28.074	12	0.005
Linear-by-Linear Association	0.845	1	0.358
N of Valid Cases	1,809		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 16.78.			

Appendix (I) : Questionnaire – Arabic version

مسح ميداني

للتعرف على مدى إنتشار الهاتف الخلوي في فلسطين و آراء الجمهور حول الخدمة بشكل عام .

ملاحظة : برجاء الإجابة بكل صراحة و مسؤولية مع العلم أن جميع الإجابات ستستخدم من قبل الباحث لأغراض البحث العلمي فقط .

تموز 2007 كلية التجارة / ماجستير إدارة أعمال -

الباحث / حسن الهندي

1. **الفئة العمرية**:
-25 سنة ( )26-40 سنة 18 سنة ( )18( ) أقل من
( )41-50 سنة ( )51 سنة فما فوق.
2. **الجنس**: ( ) ذكر ( ) أنثى
3. **الدخل الشهري** :
( ) أقل من 400 شيكل ( ) 400 حتى أقل من 1000 شيكل
( ) من 1000 حتى أقل من 2000 شيكل
( ) من 2000 حتى 4000 شيكل
( ) أكثر من 4000 شيكل.
4. **السكن**: ( ) قطاع غزة ( )الضفة الغربية .
5. **المهنة**:
( )طالب ( )موظف حكومي ( )قطاع خاص ( )أعمـال حـرة ( )لا أعمل.
6. **الهاتف الخلوي الذي لديك هو ..**
( )جوال فقط ( ) خلوي إسرائيلي ( )جوال+ خلوي إسرائيلي( ) لا يوجد
7. **هل لديك أكثر من خط هاتف خلوي واحد ؟**
( ) نعم ( ) واحد فقط ( ) لا يوجد أصلا .
8. **اعتقد أن امتلاك هاتف خلوي يعتبر...**
( ) من الضروريات ( ) من الكماليات.
9. **وسيلة الإتصال الهاتفية المفضلة لديك هي ..**
( ) الهاتف الخلوي ( ) الهاتف الأرضي
( ) كلاهما –خلوي+أرضي- ( )لا يوجد لدي وسيلة إتصال.

إذا كان لديك هاتف خلوي... برجاء الإجابة على الأسئلة الخمسة التالية :**

1. **نوع الخدمة الخلوية لديك هي ...**
( ) فلتورة ( ) كرت ( ) فلتورة + كرت
2. **الإنفاق الشهري على المكالمات لديك يقدر بـ:**
( )أقل من 50 شيكل ( )بين 50 إلى أقل من 100 شيكل
( ) بين 100 شيكل إلى 200 شيكل ( )أكثر من 200 شيكل
3. **مستوى رضائك بشكل عام عن الأداء الكلي للخدمة الخلوية التـي تحصل عليها هو ..**
( )ممتاز ( ) جيد جدا ( )جيـد ( )مقبول ( ) سيئ
4. **أغلب استخدامي للخلوي يكون لـ ..**
( ) إستقبال ( ) إرسال ( ) استقبال وإرسال المكالمات.
5. **استخدم هاتف خلوي منذ..**
( )أقل من سنة ( ) من سنة إلى أقل من 3 سنوات
( )من 3 - 6 سنوات ( )أكثر من 6 سنوات.

) في الحقل الذي يناسب رأيك علـى ✓حدد أهمية كل من العوامل الآتية التي تدفعك لإقتناء هاتف خلوي .فضلاً ضع علامة (مدى أهمية كل عامل منها:

رقم	العبارة	مهمة جداً	مهمة	متوسطة الأهمية	غير مهمة	غير مهمة إطلاقاً
.1	سهولة إنجاز المعاملات و لزوم العمل					
.2	التواصل مع العائلة و الأصدقاء					
.3	الخدمات الإضافية مثل الإنترنت و الرسائل المصورة					
.4	سعر الجهاز الخلوي الملائم .					
.5	نوع و شكل الجهاز الخلوي و ما فيه من إمكانيات.					

) في الحقل الذي يناسب رأيك ✓حدد درجة الأهمية للخدمات التي ترغب في الحصول عليها عبر الهاتف الخلوي ...، فضلاً ضع علامة (على مدى أهمية كل خدمة لديك:

رقم	العبارة	مهمة جداً	مهمة	متوسطة الأهمية	غير مهمة	غير مهمة إطلاقاً
.6	أكتفي بخدمة الإتصال الصوتي فقط					
.7	أحتاج لخدمات إضافية مثل الإنترنت و البريد الإلكتروني					
.8	أرغب في خدمات حديثة مثل البث التلفزيوني المباشر					
.9	أرغب في خدمة الإتصال المرئي صوت و صورة					

حدد درجة الأهمية لكل من العوامل الآتية عند قرارك بإختيار أو التحويل إلى شركة إتصالات خلوية أخرى ...

رقم	العبارة	مهمة جداً	مهمة	متوسطة الأهمية	غير مهمة	غير مهمة إطلاقاً
.10	جودة الخدمة المقدمة عبر مركز الإستعلامات					
.11	جودة الإرسال و قوة التغطية					
.12	السعر المناسب للمكالمات و الخدمات					
.13	توفر خدمات حديثة و متطورة					
.14	كثرة و تنوع العروض و الحملات .					

Appendix (J) : Questionnaire – English version

Field Survey

"Mobile Diffusion in Palestine and the public opinion on the services in general."

Note : Please be frankly and responsible in providing your answers. It will be used fro research purposes only.

July 2007

By: Hassan Alhendi, Faculty of Commerce, MBA Program

1. Age :

( )Less than 18 years ( )18-25 years ( ) 26-40 years ( ) 41-50 years ( ) above 51 years

2. Sex : ( ) Male ( ) Female

3. Monthly Income:

( ) Less than 400 NIS ( ) 400 to less than 1000 NIS
( ) 1000 to less than 2000 NIS
( ) 2000 – 4000 NIS
( ) Above 4000 NIS.

4. **Residence:** ( ) Gaza Strip ( ) West Bank

5. **Occupation**:

( ) Student ( ) Government employee
( ) Private Sector ( ) General Business ( ) Jobless

6. The Mobile Phone you have is …

( ) Jawwal only ( ) Israeli Cellular
( ) Jawwal+ Israeli Cellular ( ) I Don't have.

7. Do you have more than one Mobile phone ?

( ) Yes ( ) One only ( ) I Don't have.

8. I think that having Mobile Phone is a …

( ) Necessity ( ) Luxury

9.The preferable communication tool for you is …

( ) Mobile Phone ( ) Fixed Phone
( ) Both of them ( ) I Don't have

**** If you have Mobile Phone, Please answer the following :**

1- The type of Mobile service you have is …

( ) Postpaid ( ) Prepaid ( ) Postpaid + Prepaid

2. Your monthly expenditure on calls is …

( ) Less than 50 NIS ( ) 50 to less than 100 NIS
( ) 100 – 200 NIS ( ) above 200 NIS

3. The general level of satisfaction about the mobile services you receive is …

( ) Excellent ( ) Very Good ( ) Good
( ) Acceptable ( ) Bad

4. Most of my Mobile usage is for …

( ) Receiving ( ) Sending
( ) Receiving & Sending Calls

5. I am using Mobile phone since …

( ) Less than One year ( ) From 1 to less than 3 years
( ) 3-6 years ( ) More than 6 years

➢ **Specify the importance of following factors to acquire Mobile line :**

No.	Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	Easiness of performing jobs					
2.	Keep in touch with Family and friends					
3.	Extra Services like Internet and Picture messages					
4.	Suitable price of Mobile Handset					
5.	Mobile Handset brand and features					

- **Specify the importance of the service you would like to have at your Mobile :**

No.	Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	Voice Calls service only					
2.	Extra Services like internet and e-mail					
3.	Advanced services like TV Mobile					
4.	Video Call service					

- **Specify the importance of following factors to choose or switch to other service provider :**

No.	Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	Quality of service via Call Centre					
2.	Network quality and good coverage					
3.	Tariff suitable prices					
4.	Availability of new & advanced services					
5.	Diversity of offers and campaigns					

Appendix (K) : Sample Size Determination

$$n = \frac{N}{N\alpha^2 + 1}$$

n: Sample size, N: Population size, α : Level of significance (for example α =0.05).

N: Palestinian Territory, population size (Above 18 years) = 1,948,006, $\alpha = 0.05$

Then $n = \frac{1{,}948{,}006}{1{,}948{,}006 * 0.05^2 + 1} \cong 400$

West Bank population = 1,269,361 represents 65.16% of the entire population, the sample size from West Bank equals 65.16% * 400 $\cong$ 251.

Gaza Strip population = 678,645 represents 34.84% of the entire population, the sample size from West Bank equals 34.84%* 400 $\cong$ 139

***Source: Yamen, T. (1967), "Statistics, an introductory analysis", 2nd edition, Harper and Row, New York.**