HACETTEPE UNIVERSITY INSTITUTE OF POPULATION STUDIES
Technical Demography Program

# INDIRECT ESTIMATION OF INFANT MORTALITY AND UNDER-FIVE MORTALITY TRENDS FOR TURKEY FROM BIRTH-SURVIVAL HISTORIES

Ahmet Sinan TÜRKYILMAZ

A Thesis Submitted for

Partial Fulfillment of the Requirements

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**ABSTRACT**

INDIRECT ESTIMATION OF INFANT MORTALITY AND UNDER-FIVE MORTALITY TRENDS FOR TURKEY FROM BIRTH-SURVIVAL HISTORIES

The main object of this thesis is basically to apply the Miroslav Macura's indirect estimation technique to the data of the two nationwide demographic surveys, that were conducted by Hacettepe University Institute of Population Studies (HIPS), of 1978 Turkish Fertility Survey (1978 TFS) and 1993 Turkish Demographic and Health Survey (1993 TDHS).

This study provides some indirect estimates of infant and under-five mortality levels for Turkey's recent past and after 1950s from birth-survival histories. The estimations are short-term estimations and give possibility of making comparisons with other estimates. During this study the main body of the method and the formulation system were stated. In order to keep the errors minimum level a smoothing process and the use of aggregated cohorts were improved in the original method.

The results are presented for each survey with two alternative model estimates of East and Chilean. Each survey section gives the estimates of infant and under-five mortality for both sexes, males, females and five geographical regions. Beside the estimates of infant and under-five mortality rates the estimated level of East model life table of each period and estimate of life expectancy of life at birth value from Chilean model were computed.

Approximately forty years long period of the Turkish early age mortality had some new estimates for two-year long periods with the results of this study. The results show a trend also for a 10 years long period that the surveys are linking. As it is expected, the estimates from Chilean model were resulted with higher rates for both infant mortality rate and under-five mortality rate. The differences between estimates from Chilean model and East model are higher for estimates for former periods. This means, when the absolute magnitude of the rate is small the difference between estimates from the models becomes small.

The general trend of the 1978 TFS has higher rates than the 1993 TDHS. There is a discrepancy for all linking years for two surveys. The combining shape of the results of the two surveys gives a trend shape for early age mortality. The decline in the both mortality rates is consistent with a few outliers.

Comparison of the results of the study with other independent direct or indirect estimates gave a satisfactory conclusion. The estimates for the former years had closer results than the near years. The infant mortality rate estimates of the last eight years are the same with other independent estimates. The results are also consistent with the direct estimates.


Key words: Infant mortality, Under-five mortality, Life tables, Birth-survival histories, Indirect estimations

# ÖZET


## TÜRKİYE İÇİN BEBEK VE BEŞ YAŞ ALTI ÖLÜMLÜLÜK EĞİLİMLERİNİN DOĞUM TARİHÇESİNDEN DOLAYLI OLARAK TAHMİN EDİLMESİ

Bu tezin temel amacı Miroslav Macura'nın dolaylı tahmin yönteminin Hacettepe Üniversitesi Nüfus Etütleri Enstitüsü tarafından gerçekleştirilen ülke çapındaki 1978 Türkiye Doğurganlık Araştırması (1978 TDA) ve 1993 Türkiye Nüfus ve Sağlık Araştırması (1993 TNSA) verisine uygulamaktır.

Bu çalışma yakın geçmiş ve 1950'ler sonrası için bebek ve beş yaş altı ölümlülük seviyeleri için dolaylı tahminler sağlamaktadır. Tahminler kısa dönem tahminleridir ve başka tahminlerle de karşılaştırma imkanı vermektedir. Çalışma sırasında tekniğin genel yapı ve formülasyonuna uyulmuştur. Hataları minimize etmek için yuvarlama işleminde ve birleştirilmiş kuşaklarda orijinal yönteme göre bazı gelişimlerde bulunulmuştur.

Sonuçlar her iki araştırma için Doğu ve Şili modelleri kullanılarak iki seçenekli olarak sunulmuştur. Her araştırma bölümü bebek ve ve beş yaş altı ölümlülük tahminlerini toplam, kadın-erkek ve beş bölge bazında vermektedir. Bebek ve beş yaş altı ölümlülük tahminlerinin yanı sıra Doğu model hayat tabloları seviye tahminleri ve Şili model hayat tabloları için doğumda yaşam beklentisi tahminleride hesaplanmıştır.

Bu çalışmanın sonuçları yaklaşık kırk yıllık bir dönem için 2 senelik periyodlarda Türkiye için erken yaş ölümlülüğü tahminleri sunmaktadır. On yıllık bir dönem içinse tahminleri birleştirmek mümkün olmaktadır. Beklendiği üzere Şili model hayat tablolarıyla yapılan tahminler daha yüksek bebek ve beş yaş altı ölümlülük tahminleridir. Şili model ve Doğu model arasındaki farklılaşma geçmiş dönemler için daha yüksektir. Bu tahminlerdeki mutlak değer anlamında farklılığın geçmişte daha büyük olmasındandır.

Genel olarak 1978 TNA, 1993 TNSA'ya göre daha yüksek tahminler üretmektedir. Bu fark çakışan ikili yıllarda görülmektedir.İki çalışmanın birleştirilmiş sonuçlarının şekli erken yaş ölümlüğü için bir eğilim vermektedir. Birkaç aykırı değere rağmen ölümlülük oranlarındaki düşüş açıktır.

Çalışmanın sonuçları diğer direkt veya dolaylı tahminlerle karşılaştırıldığında tatmin edici bir sonuca ulaşmak mümkündür. Geçmiş dönem için üretilen tahminler yakın dönem tahminlerine göre diğer dolaylı tahminlere daha yakındır. Son sekiz yıllık dönem için tahminler diğer bağımsız tahminlerle aynıdır. Sonuçlar direkt tahminlerle de aynıdır.


Anahtar kelimeler: Bebek ölümlüğü, Beş yaş altı ölümlülük, Hayat tabloları, Doğum tarihçesi, Dolaylı tahminler

## ACKNOWLEDGMENTS

I am grateful to Assoc. Prof. Attila Hancıoğlu, my supervisor. He was always with me by not only advising me but also developing the ideas of the dissertation.

I appreciate to Professor Sunday Üner, director of Hacettepe University Institute of Population Studies (HUIPS), for his support.

I would like to express my appreciation to several people from HUIPS, some of them my instructors and some of them my colleagues. Professor Aykut Toros, Assoc.Prof. Banu Akadlı Ergöçmen, Assoc.Prof. Turgay Ünalan, Assist.Prof. İsmet Koç, Fatma Yazıcı, Tuba Dündar and Elif Kurtuluş and all administrative persons, always have been my best helpers and supported me at HUIPS.

I thank to my family, my mother, my father and my brother.

# CONTENTS

# ABBREVIATIONS

**HUIPS**: Hacettepe University Institute of Population Studies

**MHSPH** : Ministry of Health School of Public Health

**SIS**: State Institute of Statistics

**SPO:** State Planning Organization

**TDHS**: Turkish Demographic and Health Survey

**TFS**: Turkish Fertility Survey

**TGNA**: Turkish Grand National Assembly

**KAP**: Knowledge, Attitude, Practice

**IMR**: Infant Mortality Rate

**U5MR**: Under-five Mortality Rate

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**ACCEPTANCE AND APPROVAL**

This is to certify that we have read and examined this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Art in Technical Demography.

<u>Examining Committee Members</u>:

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Assist.Prof.Dr. İsmet Koç, Hacettepe University, Institute of Population Studies

This thesis has been accepted by the above-signed members of the Committee and has been confirmed by the Administrative Board of the Institute of Population Studies, Hacettepe University.

Date: 25 / 9 / 1998

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Prof.Dr. Sunday Üner

Director

TABLE 3.3.3 COMPARISON OF INFANT MORTALITY RATE ESTIMATES FOR BOTH SEXES

| PERIOD | YEAR | DIRECT | SIS 1995 | MACURA | HANCIOGLU | EAST-78 | CHILEAN-78 | EAST-93 | CHILEAN-93 |
|---|---|---|---|---|---|---|---|---|---|
| 1935-40 | 1937 | | 0.273 | | | | | | |
| | 1938 | | | | | | | | |
| | 1939 | | | | | | | | |
| | 1940 | | | | | | | | |
| | 1941 | | | | | | | | |
| 1940-45 | 1942 | | 0.306 | | | | | | |
| | 1943 | | | | | | | | |
| | 1944 | | | | | | | | |
| | 1945 | | | 0.274 | | | | | |
| | 1946 | | | | | | | | |
| 1945-50 | 1947 | | 0.260 | 0.270 | | | | | |
| | 1948 | | | | | | | | |
| | 1949 | | | 0.255 | | | | | |
| | 1950 | | | | | | | | |
| | 1951 | | | 0.245 | | | | | |
| 1950-55 | 1952 | | 0.233 | | | | | | |
| | 1953 | | | 0.235 | | 0.197 | 0.195 | | |
| | 1954 | | | | | | | | |
| | 1955 | | | 0.224 | | 0.201 | 0.198 | | |
| | 1956 | | | | | | | | |
| 1955-60 | 1957 | | 0.203 | 0.212 | | 0.199 | 0.214 | | |
| | 1958 | | | | | | | | |
| | 1959 | | | 0.199 | | 0.207 | 0.210 | | |
| | 1960 | | | | | | | | |
| | 1961 | | | 0.189 | | 0.177 | 0.189 | | |
| 1960-65 | 1962 | | 0.176 | | | | | | |
| | 1963 | | | 0.178 | | 0.167 | 0.179 | | |
| | 1964 | | | | | | | | |
| | 1965 | | | 0.169 | | 0.148 | 0.154 | | |
| | 1966 | 0.165 | | | 0.169 | | | | |
| 1965-70 | 1967 | | 0.151 | 0.156 | 0.168 | 0.143 | 0.154 | | |
| | 1968 | | | | 0.164 | | | 0.129 | 0.143 |
| | 1969 | | | | 0.161 | 0.141 | 0.153 | | |
| | 1970 | | | | 0.157 | | | 0.129 | 0.142 |
| | 1971 | | | | 0.154 | 0.137 | 0.145 | | |
| 1970-75 | 1972 | | 0.139 | | 0.151 | | | 0.123 | 0.136 |
| | 1973 | | | | 0.147 | 0.121 | 0.123 | | |
| | 1974 | | | | 0.140 | | | 0.114 | 0.128 |
| | 1975 | | | | 0.139 | 0.115 | 0.130 | | |
| | 1976 | 0.134 | | | 0.133 | | | 0.110 | 0.122 |
| 1975-80 | 1977 | | 0.126 | | 0.129 | 0.132 | 0.132 | | |
| | 1978 | | | | 0.128 | | | 0.095 | 0.105 |
| | 1979 | | | | 0.123 | | | | |
| | 1980 | | | | 0.121 | | | 0.086 | 0.094 |
| | 1981 | 0.095 | | | 0.119 | | | | |
| 1980-85 | 1982 | | 0.109 | | 0.115 | | | 0.079 | 0.085 |
| | 1983 | | | | 0.111 | | | | |
| | 1984 | | | | 0.101 | | | 0.080 | 0.086 |
| | 1985 | 0.078 | | | 0.091 | | | | |
| | 1986 | | | | 0.081 | | | 0.075 | 0.078 |
| 1985-90 | 1987 | | 0.067 | | | | | | |
| | 1988 | | | | | | | 0.062 | 0.064 |
| | 1989 | | | | | | | | |
| | 1990 | | | | | | | 0.052 | 0.055 |
| | 1991 | 0.053 | | | | | | | |
| 1990-95 | 1992 | | | | | | | 0.052 | 0.052 |

TABLE 3.3.4 COMPARISON OF UNDER-FIVE MORTALITY RATE ESTIMATES FOR BOTH SEXES

| YEAR | DIRECT | SHORTER | HANCIOGLU | EAST-78 | CHILEAN-78 | EAST-93 | CHILEAN-93 |
|---|---|---|---|---|---|---|---|
| 1953 | | | | 0.268 | 0.261 | | |
| 1954 | | | | | | | |
| 1955 | | | | 0.275 | 0.266 | | |
| 1956 | | | | | | | |
| 1957 | | | | 0.271 | 0.290 | | |
| 1958 | | | | | | | |
| 1959 | | | | 0.283 | 0.284 | | |
| 1960 | | | | | | | |
| 1961 | | | | 0.240 | 0.252 | | |
| 1962 | | | | | | | |
| 1963 | | | | 0.226 | 0.236 | | |
| 1964 | | | | | | | |
| 1965 | | | | 0.200 | 0.206 | | |
| 1966 | 0.218 | | 0.223 | | | | |
| 1967 | | 0.200 | 0.221 | 0.191 | 0.199 | | |
| 1968 | | | 0.215 | | | 0.170 | 0.182 |
| 1969 | | | 0.211 | 0.188 | 0.198 | | |
| 1970 | | | 0.204 | | | 0.170 | 0.182 |
| 1971 | | | 0.201 | 0.182 | 0.186 | | |
| 1972 | | | 0.195 | | | 0.163 | 0.172 |
| 1973 | | | 0.190 | 0.160 | 0.155 | | |
| 1974 | | | 0.180 | | | 0.150 | 0.160 |
| 1975 | | | 0.177 | 0.151 | 0.165 | | |
| 1976 | | | 0.169 | | | 0.143 | 0.153 |
| 1977 | | 0.167 | 0.164 | 0.175 | 0.168 | | |
| 1978 | | | 0.162 | | | 0.122 | 0.129 |
| 1979 | | | 0.155 | | | | |
| 1980 | | | 0.152 | | | 0.109 | 0.113 |
| 1981 | | | 0.149 | | | | |
| 1982 | | 0.142 | 0.143 | | | 0.099 | 0.101 |
| 1983 | | | 0.138 | | | | |
| 1984 | | | 0.124 | | | 0.101 | 0.103 |
| 1985 | | | 0.111 | | | | |
| 1986 | | | 0.097 | | | 0.093 | 0.092 |
| 1987 | | | | | | | |
| 1988 | | | | | | 0.076 | 0.075 |
| 1989 | | | | | | | |
| 1990 | | | | | | 0.062 | 0.063 |
| 1991 | | | | | | | |
| 1992 | 0.061 | | | | | 0.061 | 0.059 |
| 1993 | | | | | | | |
| 1994 | | | | | | | |
| 1995 | | | | | | | |

# INTRODUCTION

Turkey has an unusual demographic structure that shows interesting characteristics. Conventional demographic models or theories sometimes do not give enough or complete solutions or explanations for Turkish case. As Gürsoy-Tezcan (1991) named, “Turkish puzzle” still does not have an exact solution.

The one of the most complex part of the Turkish demographic structure is the mortality pattern of the population. High infant and maternal mortality with exceptional shapes of age-specific mortality curves shows the variance from other usual patterns. In addition, Turkish case has relatively low child, adult and elderly mortality.

Infant mortality is one of the most commonly used demographic indicators. It is an indicator of the level of development of a country, the general standard of living in a society and of health conditions specially. Cox (1975) refers that the level of the death rate in early life has been described as a crucial test of the health services and social progress of a country.

Under-five mortality is also an important indicator for the mortality. This is an indicator for the estimation of mortality during childhood. Another importance of this indicator, especially for Turkey, is usability for modeling and comparing.

Policy and decision-makers use these indicators to form population and health, policies and programs. Infant mortality rates are important for Turkey since they have been very higher than what would be expected on the basis of other demographic indicators of development. As Tunçbilek (1988) said, in Turkey, there is a strong belief that the country's present rate of infant mortality is incompatible with its current level of socio-economic development.

Infant mortality is the mortality of live-born infants who have not reached their first birthday. Infant mortality rate is the number of deaths during a specified period (often a year) of live-born infants who have not reached their first birthday, divided by the number of live births in the period, and usually expressed as per 1000 (Pressat, 1985). Similarly, under-five mortality is the mortality of the children who have not reached their fifth birthday.

Infant mortality rates have been found very high in the past and a big decline has been occurred. The big decline in the infant mortality starts from the top value, which were 306 per thousand for World War II years, 1940-1945. 15 years later, still there was a very high value 203 per thousand, which means one of every five baby dies (Shorter and Macura, 1982). In 1983, infant mortality rate (IMR) was about 101 per thousand, (1983 TFHS). According to 1993 TDHS, IMR was 53 per thousand, which is six times less than the top value in period 1940-45. 53 per thousand is still a high value, when it is compared with that of developed countries, but there is a very significant drop.

The fast improvement in the survival chances of Turkish children has been achieved by the provision of better quality health services to mothers and children, including national immunization campaigns and maternal and child care programs in priority areas of the country, as well as general improvements in social and economic conditions (Ergöçmen, Hancıoğlu, Ünalan, 1996).

The data sources, which are needed to calculate or to estimate the infant mortality rates (IMR), are mainly comes from vital registrations, censuses and surveys. For Turkey, the insufficient and unreliable structure of vital registrations is well known. So, the censuses and surveys are the main useable data sources for calculating or estimating IMR.

When the estimation techniques of IMR are considered, of course, the techniques can be classified as indirect and direct estimation techniques. If the studies, which give estimates of IMR for Turkey, are observed, it is seen that both indirect and direct estimation techniques were used in these studies.

Since vital registration data are incomplete and defective, only way of making estimations is using the data from censuses or surveys. Data from censuses give some limitations for estimating mortality indicators either directly or indirectly. For Turkey, surveys are the main sources of this kind of studies.

The census-based estimates are generally made from information on children ever born and children surviving by age of mothers. The Brass-Trussel methodology is mostly used technique (Manual X, 1983). Direct infant mortality estimates from censuses are not used for analysis or comparison purposes, since they have many deficiencies.

For non-census data sources, data on birth histories were used to make direct estimates and mainly data on children ever born and children surviving by age of mothers were used to make indirect estimates.

Beside some similar indirect techniques, there is another technique, which was developed by Miroslav Macura (1982) to estimate trends of IMR indirectly from birth-survival histories contained in the pregnancy history material of national sample surveys. Macura has applied this method to the birth-survival histories collected by the 1968 Survey. For various dates, the trend revealed by the birth-survival history method had been checked by Brass-Trussel method and some comparisons were made. Ergin (1975) used a similar approach of this method to estimate the IMR from pregnancy histories in her study.

The main object of this thesis is basically to apply the Macura's technique to data from two nationwide demographic surveys, that were conducted by Hacettepe University Institute of Population Studies (HIPS): 1978 Turkish Fertility Survey (1978 TFS) and 1993 Turkish Demographic and Health Survey (1993 TDHS).

This study aims to provide estimates of mortality levels and trends for Turkey’s recent past and after 1950s. With the help of the method, especially estimations for short periods, namely two-year periods, were considered to work for. This gives the opportunity of observing the short time fluctuations and making comparisons for both periodical and single year estimations.

This thesis is organized as follows: The first chapter gives a general demographic overview of the country and demographic data sources. In the second chapter, general information on Life Tables and Model Life Table Systems is given. As well as information on the infant and under-five mortality and the age and sex pattern of infant and under-five mortality is discussed.

A detailed description of the method of the study is explained in the next chapter. The data sources of the study, the requirements of the method, the estimation procedure and smoothing procedure are described respectively. General assumptions and considerations of the method are also discussed in addition to some variations of the method.

The chapter 3 is devoted to the application of the technique to the 1978 TFS and 1993 TDHS data. These applications provide estimations for infant mortality and under-five mortality by using two different life table models East and Chilean. These estimations are for total, sexual base and regional base.

In the conclusion, results of the study are compared, firstly for models and then for other independent estimates. A number of conclusions are given and some suggestions are made. Some life table values that are used for the estimation procedure are given in appendix. These are life table $l_x$ values (the number of persons surviving to exact age x) for odd ages up to 25 for East and Chilean models.

# CHAPTER I

# GENERAL INFORMATION ON DEMOGRAPHIC MODEL LIFE TABLES AND EARLY AGE MORTALITY IN TURKEY

## 1.1. LIFE TABLES AND DEMOGRAPHIC MODELS

### 1.1.1. Life Tables

Life table is a detailed description of the mortality of a population giving the probability of dying and various other statistics at each age. A life table is a powerful tool for the analysis of mortality (Pressat, 1988). A life table is composed of the values of various functions for persons of each age or age group. When information on each year of age is present the life table is referred to as complete or unabridged; more commonly age groups are used to produce an abridged life table.

A further distinction is between cohort life tables, expressing the occurrence of deaths within a cohort of individuals born in the same year or group of years, and period life tables which are based on the age-specific death rates of a particular period, often one year. Life tables provide the most complete and exact way of comparing mortality of different populations or groups. Their great advantage is to provide measures which are not affected by differences in age structure and also to avoid the arbitrary adoption of some standard, as do measures derived from standardization.

The functions make up the life table and express the various aspects of the mortality conditions prevailing in a population. An alternative interpretation of the life table functions is a description of a stationary population, a population whose total numbers and age distribution do not alter, and in which exactly as many births occur each year as are needed to balance the deaths indicated by the life table.

The commonly used functions in simple decrement life tables and the relationship between them can be defined in the following way for an abridged life table:

**$l_x$** The number of persons surviving to exact age x out of the original number at age zero, $l_0$ , termed the radix of the life. Usually it would be a round number such as 1 or 1,000 or 100,000. The $l_x$ function is sometimes termed as the survival function.

**$_np_x$** The probability that a person alive at exact age x will survive for further n years. (Equal to $l_{x+n} / l_x$).

**$_nq_x$** The probability that a person alive at exact age x will die before reaching age x+n. (Equal to 1 - $_np_x$ ). $_1q_0$ is the Infant Mortality rate and $_5q_0$ is the Under-five Mortality Rate.

**$_nd_x$** The number of deaths occurring between ages x and x+n. (Equal to $l_x - l_{x+n}$).

**$_na_x$** The average number of years lived in the interval between ages x and x+n by those who die in the interval. If this information is not available it will often be assumed that deaths are spread evenly over the interval. In such case the values of $_na_x$ will be taken as 0.5n. This is normally reasonable except for very young and old ages.

**$_nL_x$** The total number of person-years lived in the interval between ages x and x+n. It is also the number of people in this age group which would be found in a stationary population experiencing the mortality implied by the life table and the number of births per year equal to $l_{0.}$ (Equal to $n.l_x - {}_nd_x.{}_na_x$ or $0.5n(l_x + l_{x+n})$ if $_na_x$ is taken to be 0.5n.

**$T_x$** The total number of person years lived beyond age x and also the size of the stationary population at ages x and above. (Equal to sum of the $_nL_x$ values for all values above x.)

**$e_x$** The life expectancy at age x, i.e. the average additional number of years lived beyond age x by those who reach x. The most often quoted value of this function is $e_0$ , the life expectancy at birth. ($e_x$ is Equal to $T_x$ / $l_x$).

**$_nm_x$** The central death rate in the life table.(Equal to $_nd_x$ / $_nL_x$.)

**P or S** is the survivorship ratio. (Equal to $_nL_{x+n}$ / $_nL_x$.)

### 1.1.2. Model Life Tables

Model life table systems illustrate the variations in mortality by age and sex. They are hypothetical schedules. Model life tables form a set of mathematical relations between demographic variables. These relations are between deaths at different ages and for the two sexes.

When the determinants of the mortality pattern are discussed, a similar trend is observed. Mortality pattern starts at a high level in infancy, decreases to low levels during childhood and early adulthood, and then increases gradually in the old age. This pattern changes, from country to country, over time and between sexes.

The variation in the mortality pattern can be explained by five factors. These factors are:

- The overall level of mortality
- The ratio of child to adult mortality
- Old age mortality
- Infant mortality
- Sex differences in mortality

It is common that young children are unprotected and mortality rates are high during this period. Older children and young adults tend to have lower rates; mortality rates rise gradually during middle ages and reach highest levels at old ages. Although, widespread characteristics show the regularities in dying by age, differences in mortality behavior is the basis for the construction of different model life tables.

Model life table formation has usually taken out of the observation of underlying similarities between empirical life tables from different populations and of systematic deviations of groups of tables from this general pattern. Groups with similar deviations from the underlying pattern were used to construct models with specific characteristics different from the remaining life tables (Hancıoğlu, 1991).

Since 1950s some model life table sets have been developed and published. The model life table system can be classified into two. Some are based on a distillation of the patterns of mortality found in collections of real life tables and they can be described as 'empirical' (Newell, 1988). Others are named as 'relational'. In this study, three of the empirical life table systems are discussed. These are; The United Nations System, The Coale-Demeny System and the United Nations System for Developing Countries.

#### 1.1.2.1. The United Nations Model Life Tables

The United Nations Model Life Tables are the first model life tables which were first published in 1955 and revised in 1956 (United Nations 1955, 1956). These tables were based on 158 empirical life tables from developed and developing countries with varying qualities of data. Besides some deficient life tables, most of the other parts of the world where there are no life tables available, were not included.

While constructing those tables it was assumed that, each value of ${}_nq_x$ (probability of dying between age x to age x+n) was a quadratic function of the same parameter pertaining to the previous age group. A complex regression analysis were used to estimate the coefficients in the quadratic function. The results of the analysis set a twenty-four model life tables for each sex. They run from level 0, corresponding to an expectation of life 20 years, up to level 115 whose $e_0$ is 73.9.

The 1955 United Nations Model Life table system is a one parameter system. It does not allow the representation of variations among populations with different schedules of mortality. It is very open to errors coming from wrong selection of ${}_nq_x$ values. These life tables are not used too much nowadays but their simplicity makes them useful as an introduction to other model life table sets.

### 1.1.2.2. The Coale-Demeny Regional Model Life Tables

The Coale-Demeny Model Life tables are the most widely used model life tables. These tables were published in 1966 (Coale and Demeny 1966) and later revised and re-published in 1983 (Coale and Demeny 1983).

The Coale-Demeny Model Life Tables are very similar to the 1955 United Nations Model Life tables set which comprises twenty-five levels for each sex, from 1 to 25. They correspond to $e_0$s for females ranging from 20.0 to 80.0. Their greater flexibility when compared with the UN set comes from the above fact being a set of models for each of four ‘families’ of ‘regions’ called ‘North’, ‘South’, ‘East’ and ‘West’. The age patterns of mortality in each of the regions differ, each having relatively high or low infant, childhood, adult or old age mortality.

Coale and Demeny used raw data consisting of 326 male and female real life tables. The data excluded defective and inaccurate values and were assumed to be not affected by phonomenon such as war or epidemics. So, most of the tables are coming from Europe and other developed countries.

According to the patterns of mortality those 326 tables are divided into nine groups. Five of these nine groups, especially African and Latin American ones were rejected because of the reasons mentioned above. Four of them were used for the basis of models.

The Coale-Demeny model life tables were generated using regression procedures. The simple regression of the form

$$ {}_nq_x = a + be_{10} $$

was calculated for all age, for each sex and region separately, then the coefficients then used to compute model nqxs. The expectation of life at age 10, $e_{10}$ was chosen as the independent variable because it was considered to be a good indicator of the overall level of mortality, and relatively unaffected by the mortality rates for any one age group. Finally, 192 life tables were used to produce four models.

The four regions show these characteristics:

***North:*** This region is based on nine life tables from Norway, Sweden and Iceland. It is characterised by relatively low infant and old age mortality, but high adult mortality.

***South:*** This region is based on twenty-three Mediterranean life tables from Portugal, Spain, Sicily and southern Italy. It has high mortality under age 5, particularly among infants, low adult mortality and high mortality over age 65.

***East:*** This region is based on thirty-one Central European life tables from Austria, Germany, Bavaria, Prussia, north Italy, Poland and Czechoslovakia. It has high infant and high old age mortality, relative to childhood and adult rates.

***West:*** This region can be considered as describing some kind of average mortality pattern, and is consequently by far the most frequently used. Coale and Demeny recommend its use when no reliable information on the age pattern of mortality is available. The models are based on 130 life tables which did not fit other three groups. The model includes life tables from Netherlands, Finland, France, England, Japan, Ireland, Israel, Australia, Canada and South Africa.

#### 1.1.2.3. The United Nations Model Life Tables for Developing Countries

In order to overcome some of the limitations of the former models, the United Nations developed new life tables, which are very similar to Coale-Demeny model life tables, based on emprical life tables from developing countries. Seventy-two life tables (thirty-six male and thirty-six female) were collected from India, Iran, Kuwait, Israel, Central and Latin American Countries and South-East Asia.

Four major patterns were emerged from these life tables. These patterns were named as the ‘Latin American’, ‘Chilean’, ‘South Asian’ and ‘Far Easter’. A fifth general pattern was also produced which is an average of all the original empirical life tables. When the West model is compared with these models, following differences can explain the patterns of these models:

***Latin American:*** This model has relatively high infant and child mortality. There is also high adult mortality. Old age mortality is relatively low.

***Chilean:*** Chilean model has extremely high infant mortality.

***South Asian:*** There is high mortality under 15 and over 55, but relatively low mortality at adult ages.

***Far Eastern:*** The old ages in this family show very high mortality, particularly among males.

***General:*** This pattern is very similar to the Coale-Demeny West region.

The models are published in 1982, for each of the five patterns, for each sex they are given for expectations of life at birth from 35 to 75 years in single year intervals in a form very similar to the Coale-Demeny levels (United Nations, 1982).

## 1.2 INFORMATION ON EARLY AGE MORTALITY IN TURKEY

### 1.2.1 Information on the Age and Sex Pattern of IMR AND U5MR

It is very common that it is not possible to fit the pattern of the Turkish mortality exactly with any other models, especially for past periods. Turkish case shows a different trend. However, indirect techniques assume models so the best fit should be done for modelling.

First, Gürtan (1966) was used the United Nations model. Then Demeny and Shorter (1968) used Coale-Demeny South model. Oral (1969) tested the applicability of the Brass logit system with the African standard on Turkish mortality. She also found that the child-adult mortality relationship was not represented in the Coale-Demeny models or the Brass logit system. She pointed out that south model fit with the adult mortality, whereas it failed with child mortality.

Shorter and Macura (1982), found that model East represents the $l_5 - l_1$ relationship in the Turkish data better than the others, although it is not perfect. They also found that child mortality is heavier than adult mortality, relative to the models. Nevertheless, they state that the discrepancy between child and adult mortality has been decreasing over the years and approaching to that embodied in the models.

Demirci (1987) studied the subject using statistical methods. She tested Coale-Demeny models as well as the new UN model life tables. She found that the overall pattern is best fitted by model South and model South Asia, but recognized that fit was not good for early ages. She showed that East and Chilean models give the best fit for childhood ages. On the other hand, West and General models give the best fit for the adult ages.

Hancıoğlu (1991) discussed the patterns of early age mortality in his study. He pointed out some important comments related to the subject. As he said, the Turkish values cover a wide range of mortality levels. These values are assumed to represent a dynamic portrait of the age pattern of Turkish childhood mortality. Despite the figures coming from different sources and different procedures for different dates, they are regarded as simulating the real change of the age pattern of childhood mortality that has occurred in Turkey.

Hancoğlu has defined an error index for the comparisons of actual Turkish IMR and U5MRs with model values. The results show that the Chilean and East models are the best predictors of IMR given U5MRs.  Except for the studies of Demirci (1987) and UN (1990), up to Hancıoğlu's discussions, the East model was assumed to represent the age pattern of childhood mortality. But, he showed that the use of Chilean pattern will produce smaller bias and will not lead consistent underestimation or overestimation.

Hancıoğlu has done his study not only for early age mortality, but also for post-childhood mortality, relationship between child-adult mortality and overall patterns. He summarized his results in a table, that shows how Turkish case fits or does not fit with the models. Below table shows the results of his analysis of Turkish mortality patterns.

TABLE 1.2.1.1. SUMMARY RESULTS OF THE ANALYSES OF TURKISH MORTALITY PATTERNS

| PROBLEM | INDICATORS USED | TYPE OF ANALYSIS | BEST MODEL |
|---|---|---|---|
| A. PATTERNS DURING CHILDHOOD | | | |
| Age Pattern Below age 5 | U5MR<br>IMR | Percentage Errors (E(T)) | Chilean |
| Age Pattern Below age 25 | ${}_{25}q_0$<br>IMR | Percentage Errors (E(T)) | Chilean |
| Sex Pattern Below Age 5 | Female and Male U5MR | Percentage Errors (ES(T)) | West |
| B. POST-CHILDHOOD MORTALITY PATTERNS | | | |
| Age Pattern Above age 5 | $e_x$ from x=5 to x=75 | Errors in Implied $e_5$ ($R_x$) | West |
| Age Pattern from Age 20 to 64 | ${}_5q_x$<br>x=20 to 60 | Standard Deviations of Implied $e_0$ | West |
| C. RELATIONSHIP BETWEEN CHILD-ADULT MORTALITY | | | |
| Relationship between levels of Child and Adult Mortality | IMR<br>$e_5$ | Graphics Only | None |
| D. OVERALL PATTERNS | | | |
| Overall Age Patterns | ${}_nq_x$ | Ratios of ${}_nq_x$ to West model Graphics | None |
| Overall Sex Patterns | Female and Male $e_0$ | Percentage Errors (E(T)) | East |

SOURCE: HANCIOĞLU (1991)

### 1.2.2 Direct and Indirect Estimates of Infant and Under-Five Mortality

Although the registration system in Turkey have been set up by legal instruments and for legal purposes, and it is also a compulsory one for a long period, system does not work well and have problems because of some deficiencies, complications and inefficiencies in practice and due to bureaucracy in the process, The information on Turkish mortality is based particularly on direct and indirect estimates from census and survey data.

Since the estimates are based on survey and census data, sampling and non-sampling errors for survey data and response and coverage errors for censuses affects the reliability and accuracy of the estimates. Moreover, indirect estimates themselves are most of the potential source of the errors due to some assumptions for Turkish case. The estimates are discussed as direct and indirect estimates:

#### 1.2.2.1 Direct Estimates

The Turkish Demographic Survey (1965-68 TDS) provided valuable information on mortality. It was conducted by Ministry of Health School of Public Health (MHSPH). TDS was fielded as a dual-record survey, using two independent systems of data collection. Collected data were corrected by Chandrasekar-Deming technique, for omissions of vital events in either of the two systems. Representative population, which is quite large, is about 240.000. The main objective of the TDS was to collect, on a regional basis, reliable data on fertility and mortality, as well as other demographic characteristics. It is a very good survey in terms of providing relatively good quality and detailed data on overall mortality. So, this survey supplies data on mortality levels and patterns for the 1965-1967 period. The first empirical life tables for the country were constructed from the mortality data of this survey. Alpay (1969), SIS (1971) and Özkan (1974) constructed life tables. Shorter and Macura had also used these survey for many estimations. Later Hancıoğlu (1991) reconstructed Özkan’s life tables. Hancıoğlu (1991) gives some IMR and U5MR estimates from these tables for total, regions, for urban and rural areas. He named the estimates as revised estimates and, estimated IMR as 165 per thousand and U5MR as 218 per thousand.

TABLE 1.2.2.1 DIRECT ESTIMATES OF IMR AND U5MR FROM 1965-68 TDS

| | TURKEY | WEST | SOUTH | CENTRE | NORTH | EAST |
|---|---|---|---|---|---|---|
| IMR | 0.165 | 0.144 | 0.139 | 0.197 | 0.141 | 0.193 |
| U5MR | 0.218 | 0.181 | 0.181 | 0.262 | 0.189 | 0.260 |

SOURCE: HANCIOĞLU (1991)

Beginning with 1978, HUIPS fielded four nationwide fertility surveys with similar contents at five-year intervals. These surveys actually continued the series of one-in-every five years surveys, which were previously conducted in 1968 and 1973. However, the 1978, 1983, 1988 and 1993 surveys have to be considered under a different category because of their similar structures, contents and themes.

1978 The Turkish Fertility Survey (1978 TFS) is a result of a close collaboration between the World Fertility Survey and HUIPS. Report consists of two volumes. Data were obtained on nuptiality, fertility, infant and child mortality and contraceptive usage. It was a cross-sectional survey of 5142 households and 4431 ever-married women sampled by a clustered, stratified multistage area design on regional basis. The direct estimates of infant and child mortality were calculated in the light of available information. Information on orphanhood and maternity/pregnancy history is also available.

1983 "Turkish Fertility Contraceptive Prevalence and Family Health Status Survey" (1983 TPHS) provides, for the first time, information on health status of families, mother and child care and family planning services. This cross-sectional survey had a sample size of 6545 households and 5398 women selected by a stratified multistage element sampling procedure. 1983 survey had also fertility and contraceptive use as its main themes, But this time, migration and employment replaced with health problems are, specifically related to fertility and child survival. Data from the 1983 survey is available in raw form. In the survey report, the main results, which includes the estimates of infant mortality by leaving out the data obtained from questions on deaths in the three years preceding the survey, is presented. Deaths by age and sex, brass-type questions, orphanhood data and maternity/pregnancy history are available

1988 “Turkish Population and Health Survey " was conducted by HUIPS. Being the third survey (after 1968 and 1963 surveys), which collected husbands' knowledge, attitude and behavior on fertility with the help of husband's questionnaire is an important point of this survey. The sample of this survey was also selected by a multistage stratified cluster sampling procedure with 6552 households and 5257 ever-married women. The themes of the survey are greatly similar to the 1983 survey with the exclusion of questions on births and deaths in the household during the three years succeeding the survey date. The report presents the main results of the 1973, 1978 and 1983 surveys. Raw data are available. This is the only survey which gives widowhood information, in addition to that of orphanhood and maternity/pregnancy history.

1993 "Turkish Demographic and Health Survey (TDHS) “ is a nation-wide sample survey of women of reproductive age designed to provide, among other things, information on fertility, family planning, child survival and health of children. The survey collected data on major health phenomena, fertility and infant and child mortality. In addition to providing information, the TDHS serves as a source of demographic data for comparison with earlier surveys conducted by HIPS. The 1993 TDHS is a survey of 8619 households and 6519 ever-married women. In terms of the activities undertaken during the survey, the TDHS involves not only household and women's questionnaires but also cluster questionnaire to be filled in for each cluster visited by the fieldwork teams. Two other important aspects of the TDHS are anthropometric measurements of mothers and children and entry of data during the fieldwork by selected fieldwork teams. For infant and child mortality, there is a separate chapter, which presents very detailed analysis by taking care on selected background and demographic characteristics. There are Brass-type, orphanhood and maternity/pregnancy history questions in the survey.

Below table shows the direct estimates of infant mortality from HUIPS Surveys.

TABLE 1.2.2.2.DIRECT ESTIMATES OF IMR AND U5MR FROM THE 1978 TFS, 1983 TPHS, 1988 TFHS, 1993 TDHS (PER 1000)

| SURVEY | PERIOD | TURKEY | WEST | SOUTH | CENTRE | NORTH | EAST |
|---|---|---|---|---|---|---|---|
| 1978 | 1972-77 | 0.134 | 0.108 | 0.109 | 0.151 | 0.141 | 0.147 |
| 1983 | 1979-82 | 0.095 | 0.081 | - | 0.103 | 0.097 | 0.119 |
| 1988 | 1985-87 | 0.078 | 0.045 | 0.096 | 0.090 | - | 0.103 |
| 1993-IMR | 1988-93 | 0.053 | 0.043 | 0.055 | 0.058 | 0.044 | 0.060 |
| 1993-U5MR | 1988-93 | 0.061 | 0.048 | 0.063 | 0.069 | 0.050 | 0.070 |

Sources: HUIPS (1980; 1987; 1989; 1994)

Although, Rutstein (1989) calculated some early age mortality indices using the data from the 1988 TFHS, Hancıoğlu (1991) claimed that, there were several problems associated with those estimates.

**1.2.2.2. Indirect Estimates**

The study of Shorter and Macura (1982) is one of the most important studies of mortality in Turkey. They produced different estimates by using different techniques. They used Brass child survivorship technique on the census data and used Macura technique, which is the base of this thesis, on the pregnancy history data of the 1968 Survey. 1968 “Social Survey on Family Structure and Population Problems in Turkey " was conducted by HIPS. It has a national sample of 3300 currently married women. Information on the fertility of currently married women is comparable to the 1963 survey. It is possible to find deaths by age and sex, brass-type questions and maternity/pregnancy history from the survey.

After the foundation of Republic, in order to determine the quantitative, social and economic characteristics of the population, censuses had started to be taken. The first census was conducted in 1927. This was followed quinquinnally starting with 1935. From there on, censuses have been taken at five-year intervals. The population census of 1990 was the 13th and the last census realized in Turkey because after 1990 it was decided to take the next census in year 2000. A Population count was conducted in November 1997. It was aimed to count de facto and de jure population of the country, which was required especially for elections.

In the last five censuses same questions were asked about the number of children ever born and children surviving, from which childhood mortality estimates can be derived by applying Brass type procedures. There are also direct questions on infant mortality. For the censuses of 1970 and 1975, special question on the number of total children who died before reaching their first birthday was asked to all ever married women aged 12 and plus, and for the censuses 1980 and 1985 the same question was asked with limiting the time of occurrence to the preceding year. The 1990 census made an attempt to obtain data on deaths among the last born children of women up to two years before the census date. The question was asked for the last live birth and put a date on that birth. Then another question asked whether the child was alive or dead by the census date.

Although there are some limitations in terms of data quality, censuses are valuable data sources for the estimation of mortality rates. Many studies have used indirect estimation techniques, generally versions of forward projection, to estimate levels of mortality. In censuses, the most serious deficiency concerning mortality is information about age 20 up to the end of life. But this problem can be accepted natural due to technical reasons about designing censuses.

Mainly two types of errors are encountered with Turkish census data. The first is reporting errors, which can be in the form of age misreporting, underreporting of births and misreporting of various other characteristics. The second is coverage errors, which can be age or sex selective, or for that matter, selective in terms of characteristics. It is known that significant margins of error are deficit in the census statistics, as in the case of completed fertility and infant mortality.

Shorter and Macura (1982), estimated the infant mortality rates for Turkey as 176, 151 and 126 per thousand for the periods 1960-65, 1965-70 and 1970-75, respectively from censuses. There were some studies estimating child mortality by child survivorship method. For

Instance Cerit (1989) and Shorter (1989) estimated the early age mortality with these techniques by using census data.

TABLE 1.2.2.3 SOME INDIRECT ESTIMATE OF IMR AND U5MR IN TURKEY

| SOURCE | PERIOD | IMR | U5MR |
|---|---|---|---|
| SHORTER & | 1960-65 | 0.176 | |
| MACURA | 1965-70 | 0.151 | |
| SHORTER | 1967 | 0.149 | 0.200 |
| | 1977 | 0.126 | 0.167 |
| | 1982 | 0.109 | 0.142 |
| CERIT | 1980 | 0.117 | |
| | 1985 | 0.103 | |

SOURCES: SHORTER AND MACURA (1982); SHORTER (1989); CERIT (1982)

Hancıoğlu (1991) estimated infant mortality and under-five mortality rates indirectly by using the data on children ever born and children surviving. In his estimates, besides censuses 1980 and 1985, the data of three nation-wide surveys (1978 TFS, 1983 TPHS and 1988 TFHS) were also used. He applied the child survivorship technique to the survey and census data while taking the Chilean model as base. He has provided singe year and period estimates for both sexes, male, female, regions and urban/rural. He made median estimates for different sources. Single year median estimates of infant and under-five mortality are available for years 1966 to 1986.

TABLE 1.2.2.4. ESTIMATES OF IMR AND U5MR FOR 5-YEAR PERIODS FROM 1970 TO 1985, BY SEX

| PERIOD | | 1970-75 | 1975-80 | 1980-85 |
|---|---|---|---|---|
| MALES | IMR | 0.162 | 0.145 | 0.123 |
| | U5MR | 0.203 | 0.180 | 0.150 |
| FEMALES | IMR | 0.138 | 0.123 | 0.103 |
| | U5MR | 0.181 | 0.158 | 0.129 |
| BOTH SEXES | IMR | 0.148 | 0.129 | 0.110 |
| | U5MR | 0.191 | 0.163 | 0.136 |

SOURCE: HANCIOĞLU (1991)

TABLE 1.2.2.4. HANCIOĞLU'S ESTIMATES OF IMR AND U5MR FOR REGIONS BY 5-YEAR PERIODS FROM 1970 TO 1985 (HANCIOĞLU, 1991)

| | WEST | SOUTH | CENTRE | NORTH | EAST |
|---|---|---|---|---|---|
| **IMR** | | | | | |
| 1970-75 | 0.132 | 0.135 | 0.166 | 0.147 | 0.158 |
| 1975-80 | 0.109 | 0.121 | 0.147 | 0.128 | 0.145 |
| 1980-85 | 0.092 | 0.103 | 0.119 | 0.107 | 0.131 |
| **U5MR** | | | | | |
| 1970-75 | 0.167 | 0.172 | 0.217 | 0.186 | 0.206 |
| 1975-80 | 0.135 | 0.152 | 0.189 | 0.162 | 0.186 |
| 1980-85 | 0.112 | 0.127 | 0.149 | 0.133 | 0.166 |

In a study done by State Institute of Statistics (SIS) in 1995 in addition to other main demographic topics, many mortality estimations are presented. This study provides direct or indirect estimations from surveys and censuses. There are some census based indirect estimations of IMR for regions and big cities. A big table in the publication summarizes and combines the estimations of mortality indicators. Below table shows the IMR and e(0) estimations. IMR estimations for the periods between 1935 and 1970 are the estimations of Shorter and Macura (1982).

TABLE 1.2.2.5 IMR AND e(0) ESTIMATIONS FOR TURKEY (SIS 1995)

| PERIOD | IMR | e(0) | | |
|---|---|---|---|---|
| | | MALE | FEMALE | BOTH |
| 1935-40 | 0.273 | 34.68 | 36.23 | 35.43 |
| 1940-45 | 0.306 | 30.10 | 32.65 | 31.34 |
| 1945-50 | 0.260 | 36.68 | 39.59 | 38.10 |
| 1950-55 | 0.233 | 41.96 | 45.16 | 43.52 |
| 1955-60 | 0.203 | 44.68 | 48.63 | 44.61 |
| 1960-65 | 0.176 | 47.93 | 52.02 | 49.93 |
| 1965-70 | 0.151 | 51.07 | 55.27 | 53.12 |
| 1970-75 | 0.139 | 52.99 | 57.30 | 55.09 |
| 1975-80 | 0.126 | 54.78 | 59.37 | 57.01 |
| 1980-85 | 0.109 | 56.88 | 61.32 | 59.04 |
| 1985-90 | 0.067 | 62.67 | 67.26 | 64.91 |

# CHAPTER II

# METHODOLOGY

## 2.1. DATA SOURCES OF THE THESIS

The “1978 Turkish Fertility Survey” (1978 TFS) and the “1993 Turkish Demographic and Health Survey” (1993 TDHS) are the data sources for this thesis.

### 2.1.1. The 1978 Turkish Fertility Survey (TFS)

The 1978 TFS is a nationwide survey carried out by HIPS. It was conducted under the auspices of the World Fertility Survey. The 1978 TFS was a cross-sectional survey of 5142 households and 4431 ever-married women sampled by a clustered, stratified multistage area design on a regional basis. The sample was a self-weighted one, making possible the straightforward calculation of conventional statistical measures. The main themes of this survey were fertility and contraceptive use. The direct estimates of infant mortality and child mortality are available in the survey report. The survey report consists of two volumes.

The individual questionnaire was made up of seven sections as follows:

- Respondent's background
- Birth history
- Marriage history
- Contraceptive use and knowledge
- Fertility regulation
- Work history
- Husband's background

The birth history section gives the required information for this study. The region, the date of the interview, the sex of the child, the date of birth of child and the date of death of child (if the child deceased) variables were used. New variables were created in order to get appropriate results for analyses. These variables used for calculating the desired proportions for desired cohorts.

### 2.1.2. The 1993 Turkish Demographic and Health Survey (TDHS)

The 1993 Turkish Demographic and Health Survey (TDHS) data set is the second data source in this thesis. The 1993 TDHS was conducted as part of the worldwide Demographic and Health Surveys (DHS) program, by the Hacettepe University, Institute of Population Studies (HUIPS) under a subcontract through an agreement between the General Directorate of Mother and Child Health and Family Planning, Ministry of Health and Macro International Inc. of Calverton, Maryland. The survey was designed basically to provide information on fertility levels and trends, infant and child mortality, family planning and maternal and child health.

The TDHS was a nationally representative survey of ever-married women aged 15-49. A weighted, multistage, stratified cluster sampling approach was used in the selection of the sample. Fieldwork was conducted in the summer of 1993. During the survey 8,619 households and 6,519 eligible women were interviewed in these households. Two main types of questionnaires were used to collect the TDHS data: the Household Questionnaire and the Individual Questionnaire for ever-married women of reproductive ages. The Household Questionnaire contained a household list and included characteristics such as age, sex, education, marital status of the household members and in second section information on housing characteristics was obtained (HUIPS, 1994).

Individual questionnaire contains the following sections:

- Background characteristics
- Reproduction
- Marriage

- Contraception
- Pregnancy and breastfeeding
- Immunization and health
- Fertility preferences
- Husband's background and woman's work
- Values, attitudes and beliefs
- Maternal and child anthropometry

In the analyses, following variables were used: “date of interview”, “major 5 regions”, “sex of child”, “province born”, “date of birth of child”, “whether child is still alive” and “age at death (if the child deceased)”. Besides these variables, new variables were constructed in order to calculate the proportions for new cohorts and some new region definitions. Here children were regrouped according to their province where they were born. Details and reasons of forming these new variables will be discussed in following sections.

## 2.2. MACURA’S ESTIMATION TECHNIQUE

In this section, Miroslav Macura’s original method will be discussed. Macura has described a method to estimate the time trends of infant and early childhood mortality from birth-survival histories collected in a single sample survey. This method is a kind of reverse projection and it gives the infant mortality trends twenty-five - thirty years back. The sentence that he wrote in his book with Shorter gives the main idea of the method: “*Numbers of births in the past and the survival status of those children logically imply measures of past infant and early childhood mortality levels*” (Shorter and Macura, 1982). Method uses proportion of deceased children in a given cohort and sets a system of equation, which is showing a life table relationship between these cohort proportions, and the cohort’s probabilities of surviving.

Macura first used this method to present the estimates of infant mortality trends for the national and for several subnational populations of Turkey (Macura, 1975). Macura calculated his estimates from the birth-survival histories recorded in the 1968 Population

Problems and Family Structure Survey. He also used this method in his famous study titled "Trends in Fertility and Mortality in Turkey, 1935-1975" with Frederic Shorter (Shorter and Macura, 1982).

### 2.2.1. Data Requirements of the Method

The data collected in birth-survival histories are needed in application of the method. The following information concerning each live born child are used:

- date of birth
- survival status
- date of death (if the child died)

In order to compute the proportion of deceased children prior to the survey year, the children are distributed by year of birth (or by specified cohorts) and by their survival status. The proportion of each cohort is computed as a ratio of the number of the deceased children in a cohort to the total number of children born in the cohort.

### 3.2.2. Estimation Procedure of the Method

The proportion of deceased children in a cohort age "a" is denoted by **d(a)** and $\mathbf{L_a}$ be the life table number of person-years lived between exact years age "a" and "a+1". The time is measured in terms of single years from t=0 which represents the origin.

There is an equation showing an existing relationship between a cohort proportion of deceased children and the cohort's probabilities of surviving through consecutive calendar years between birth and end of t=0. If the life table radix $l_0=1$ and an expression is written for **d(a)** of each cohort, starting with one born in t=0, then the following system emerges:

| | | | |
|---|---|---|---|
| 1 | - | $(L_o)_o$ | $=d(0)$ |
| 1 | - | $(L_o)_1 * (L_1/L_0)_0$ | $=d(1)$ |
| 1 | - | $(L_o)_2 * (L_1/L_0)_1 * (L_2/L_1)_0$ | $=d(2)$ |
| . | | | . |
| . | | | . |
| . | | | . |

Where subscripts of the survival ratios denote calendar years.

This system of equation can be expressed as following formula:

$$d(t) = 1-(L_0)_{(t)} \prod_{i=1}^{t-1} (L_i / L_{i-1})_{(t-i)}$$

where, ( i=1,2, 3, ....., t-1) and (t=0,1, 2, ....., n)

The infant mortality rates and under-five mortality rates can be estimated indirectly by solving above equations, if the information on proportion of deceased children (d(a) values) are available from the birth survival histories.

This equation system can be solved by means of the model life tables. A model life table system, whose age pattern of mortality is the closest to the age pattern of mortality existing in the population, should be selected. Some calculations are needed, in order to use all single year life table values. These single year life table values should be available for computation.

The estimation procedure works in following way:

- First step of procedure is locating a life table where the first equation of the system is satisfied by embodying the $L_0$ value. Of course, it is not possible to find exact $L_0$ or other L values satisfying all equations. Here the main work is calculating all single year life table values by interpolating linearly among the selected life table integer levels, where our $L_0$ value takes place. Then we have a new calculated life table column and its numbers those will be used later in other equations of the system. The value of ${}_1q_0$ in the new table is assumed to be our infant mortality rate estimation for t=0.

- In the next step, a new table should be located for t=1. Here t=1means two years before the survey year. Given $(L_1/L_0)_0$ from the table which was calculated for t=0 and using d(1) value, the $L_o$ value is embodied for t=1 by satisfying the second equation of the system. Here also another life table should be calculated by interpolating linearly among the model life tables at levels of mortality. The value of ${}_1q_0$ in the second new table is our infant mortality rate estimation for t=1. The values of this table will also be used for other steps of estimation.

- Next, for the given d(2) value, the given $(L_1/L_0)_1$ value from the table for t=0 and the given $(L_2/L_1)_1$ value from the table for t=1, the table for t=2 which embodies the $L_0$ that satisfies the third equation is located. The value of ${}_1q_0$ in the third new table is our infant mortality rate estimation for t=2.

This estimation procedure runs up to the last cohort. When the model tables are located, the trend estimate is reached by calculating the infant mortality rates from tables.

### 2.2.3. The Smoothing Process of the Macura's Method

**E**stimation procedure which was discussed above works with non-defective data. If the data are accurate, then the proportion of diseased children (d values) can be directly used in the calculations. If mortality falls down or does not change too much over time and if data are non-defective, cohort proportions of diseased children increase as the cohort year of birth moves backward from the survey year. If mortality experiences short-run fluctuations, the time schedule of proportions has zig-zags accordingly. However, if data is defective, the zig-zags in the proportions can not be explained by short-run mortality fluctuations. These extreme variations in the proportions might be due to of unsystematic or more or less random misreporting of year of birth and sampling variance. Both sampling variance and misreporting of year of birth affect proportions of cohorts born at early dates, more than, proportions of cohorts born at dates closer to the survey date. These proportions can also be affected by the omission of the deceased children. And also they can be affected by a misreporting of birth year takes a form of extra aggregating time of occurrence of births. When the omission and the systematic misreporting occur, the proportions rise less perpendicular than they should as the cohort year of birth moves back t=0.

If the method is applied to defective data, the trend estimation will also be defective, too. If the proportions are defective because of sampling variance or random misreporting effects, upward biased proportions cause estimates of particular years to be extremely high. On the other hand, downward biased similar annual estimates to be undervalued. Moreover, if the proportions are defective due to systematic misreporting or as a result of omission or both, estimates at earlier dates depressed and overall mortality decline is underestimated.

It is not possible to make any corrections or smoothing for removing errors in estimates beginning from the omission of the children and the misreporting that extra aggregate time elapsed since birth. Conversely, it is possible to remove biases arising from the other two causes of data errors. In order to remove these biases a smoothing process is required.

Macura has used a smoothing method, which tries to correct or smooth proportions by plotting some straight lines. In that smoothing process the trend of the proportions are accepted to be linear. Macura smoothes the proportions as follows. The proportions are first plotted against time and approximated by a smooth time schedule of proportions. Then, the schedule is converted into a trend estimate. The time period spanned by the schedule is divided into two intervals of approximately equal length. A ratio is calculated for each interval. The dominator of the ratio is the reported number of the deaths occurring prior to the survey in cohorts born within the interval. The numerator is the number of deaths that would have occurred before the survey if the cohorts within the interval had been exposed to mortality condition consistent with the smooth proportions. This number is computed as a sum of deaths that would have occurred in annual cohorts born within the interval.

Macura has formulated his smoothing process in the following way. He has denoted the smooth proportion dead in *a* years old at the time of the survey as $d_a$' and $S_a$ be the reported number of children belonging to the cohort who survive till the survey. The number of deaths implied by $d_a$' is denoted by $D_a$', where $D_a$' is calculated as $d_a$'. $S_a$ / (1-$d_a$'). The formula is derived from the definition of the proportion dead $d_a = D_a / (D_a + S_a)$, where $D_a$ is the actual number of cohort deaths.

The ratio for the time intervals is computed by:

$$\frac{\sum_{a=a_1}^{a_2} D_a'}{\sum_{a=a_1}^{a_2} D_a}$$

Where *a* is an age variable and $a_1$ and $a_2$ are years of age at the end of t=0 of cohorts born in the latest and the earliest years of the interval, respectively.

If the smoothing gives insufficient approximation of the observed proportions, the portion of the trend which refers to a few years prior to t=0 is saw-toothed or kinked and/or one or both ratios differ markedly from unity. The ratio for a particular interval that exceeds (or falls) unity results from smooth proportions which on the average exceed (or fall) the corresponding observed proportions. Generally, it is required to draw a few smooth schedules before the one that approximates observed proportions while giving unity. The ratios implied by this schedule are close to unity and the trend obtained is smooth throughout.

#### 2.2.3.1. Use of aggregated cohorts

Use of aggregated cohorts is preferable for saving the time and effort entailed in estimating the trends. Moreover, aggregation procedure increases the number of observations for each cohort. Macura has used two-year cohorts for aggregation. It is possible to use three or five year cohort proportions. But, in order to control the imprecision arising from the aggregation itself, two-year cohorts are favorable.

When two-year cohort proportions are used in estimating the trends the life table system of equations should be arranged for new procedure. This new equation system works with $l_x$ variable instead of $L_x$ variable.

The new system is as follows:

| | | | |
|---|---|---|---|
| 1 | - | $(l_1)_{0-1}$ | =d(0-1) |
| 1 | - | $(l_1)_{2-3} * (l_3/l_1)_{0-1}$ | =d(2-3) |
| 1 | - | $(l_1)_{4-5} * (l_3/l_1)_{2-3} * (l_5/l_3)_{0-1}$ | =d(4-5) |
| . | | | . |
| . | | | . |
| . | | | . |

Here, d(a – a+1) stands for the proportion dead in the cohort age a to a+1 at the end of t=0, where a=0,2,4,….,2n. Subscripts (0-1), (2-3), (4-5),…. stand for the time intervals or periods zero to one, two to three, four to five years before the end of t=0. $l_x$ value is a standard life table number of persons reaching exact age x, where x=1, 3, 5, 7, ……., 2n+1.

This system of equation can be expressed as following formula:

$$d(t) = 1-(l_1)_{(t)} \prod_{i=1}^{t-1} (l_{2i+1}/l_{2i-1})_{(t-i)}$$

In the formula; (i=1,2, 3, ....., t-1), (t=0,1, 2, ....., n)

In this formula t turns for each two-year cohort, in other words, t=0 means a=0 and a+1=1, t=1 means a=2 and a+1=3, t=2 means a=4 and a+1=5, and so on…

The ratios that are used in Macura's smoothing process are calculated with different formulas for two-year cohorts. In order to write the new formula, let $D_{a\text{-}a+1}$ and $S_{a\text{-}a+1}$ stand respectively for numbers of children dying prior to the end of t=0 and children surviving till the same date in a cohort age a to a+1. Let $d'_{a\text{-}a+1}$ and $D'_{a\text{-}a+1}$ stand respectively for the smooth proportion dead of the same cohort and cohort's expected number of dead consistent with the smooth proportion. The expected number deceased is computed using the formula:

$$D'_{a\text{-}a+1} = d'_{a\text{-}a+1} \,.\, S_{a\text{-}a+1} / (1 - d'_{a\text{-}a+1})$$

On the other hand, the ratio of the smoothing process for two-year cohorts can be written as:

$$\frac{\sum_{a=a_1}^{a_2} D'_{a-a+1}}{\sum_{a=a_1}^{a_2} D_{a-a+1}}$$

### 2.2.4. Assumptions and General Considerations of the Method

This method works under some assumptions. The results of estimations should always be discussed by considering these assumptions and data errors. Since the application of the method entails the use of model life tables, the first assumption of the method is the similarity between an age pattern of mortality embodied in the model life table and the corresponding age pattern of the population for which the trend is estimated. The second assumption of the method is that there is no association between mortality of women and mortality of their children. The third one is that the effect of rise of new urban communities arising from population growth and effect of transfers of childhood mortality experience from rural to urban communities is small.

The effects of migration of women and of resulting transfers of infant and early childhood mortality experiences across national and residential boundaries are also assumed to be minor. In this thesis, this assumption considered as a little different from the original. The question of "the province born" in birth-history section of the 1993 TDHS gave the opportunity of grouping the children according to their province where they were born. Therefore, the estimations in regional base from 1993 TDHS does not need that assumption.

Beside these assumptions, the errors in data affect the accuracy of estimations. As mentioned before, the omission of the children who either die or leave home prior to the survey, the misreporting of birth year that overestimates or underestimates the number of years elapsed since birth, in addition the misreporting of the death date, and the sampling variance are the main sources of the data errors.

The omission of the children is not a major source of error especially for 1993 TDHS. The structure of the birth-history section and the household questionnaires of the surveys keep this omission at minimum level. These omissions probably occur for mainly female children in East region for past surveys.  Misreporting of births is still another possible source of inaccuracy, although, related age reporting indexes gives better results for 1993 TDHS.

Sampling variance, which is because of too few observations, especially for north and south region in 1978 TFS, is one of the most important causes of inaccuracies in the estimates. In order to balance adverse effects of the sampling variance and the random misreporting, smoothing was incorporated into the estimation. In many cases, smoothing keeps biases associated with data problems. But, it is possible that, smoothing may not be always useful, when the number of the children included in birth survival histories is very limited or when there is a misreporting of year of birth, smoothing process does not help well. The trend is much related to the smoothing.  An assumption on similarity between the actual population and the model age patterns of mortality is certainly not satisfied. The use of the models introduces some bias.

## 2.3 SOME CHANGES IN THE MACURA'S TECHNIQUE

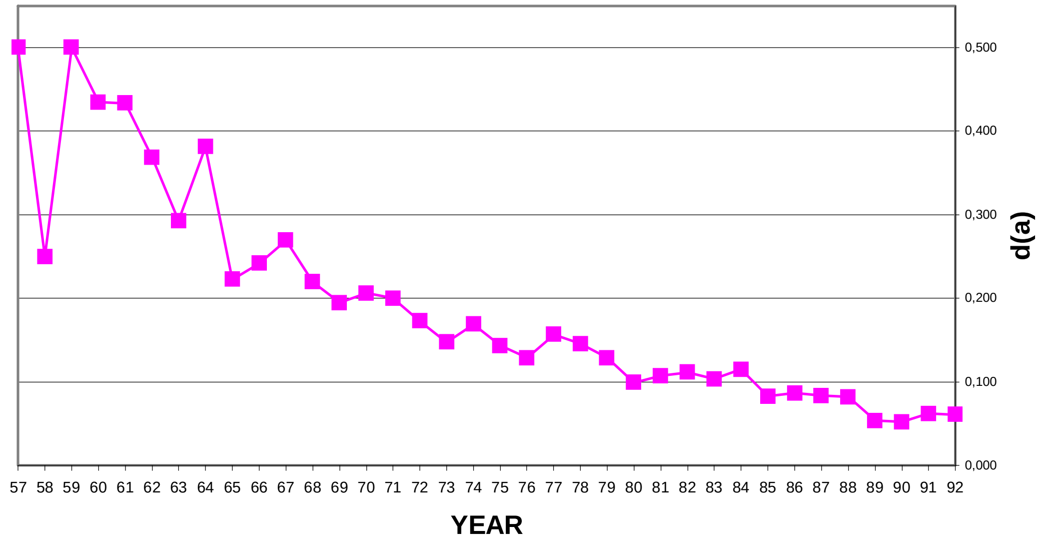
In this study the original method of Macura's were applied to the two nation-wide survey data. During the application the main body of the estimation procedure and the formulation systems were stated. However, some new ideas or some differences or alternatives due to of the data sources allow some changes or revisions in the technique.

The information used for the technique again was taken from the birth-survival histories. The first manipulation was conducted during the calculation process of the basic proportions of deceased children. In the original method, these proportions were calculated prior to the survey year. This means the children who were born in the survey year were not taken into account. Most of all, this is a very important data loss. Moreover, When the reporting of the births and deaths of children was especially very close to survey date, this has given rise to an accuracy of the information.

Since the both 1978 TFS and 1993 TDHS allow to use the exact dates of interviews and dates of births and deaths of the children, the proportions of deceased children were calculated prior to the survey date.

In this study, two-year aggregated cohorts were used as it was in the original study. At the beginning of the study the alternatives of using single-year proportions or five-year cohort proportions were also experimented. While single year proportions were showing too many fluctuations, five-year proportions had linear trends. In order to see the short-term estimates and to keep the consistency with the original estimation procedure, two-year cohorts were chosen in calculations. The fluctuations in single year estimations were presented in Figure 2.3.1. The proportions in this figure were calculated as in the original method, in other words they were calculated as prior to the survey year. Especially for the past years, the fluctuations in the proportions can explain the reason why single year proportions were not chosen.

**FIGURE 2.3.1. d (a) PROPORTIONS FOR SINGLE YEARS FOR BOTH SEXES (1993 TDHS)**




Since the calculations of proportions were done in accordance with the survey date, two-year cohort estimates may cause confusion while defining the period. Here, periods were named as 93-91, 91-89, and 89-87. The interviews were carried out generally in August, September or October of the Survey years. Therefore, If we accept the idea that September is the mean time for surveys, 93-91 means that period estimates cover from September of 1993 to September of 1991. In other words, these two-year estimates may refer to the mean date of the period which is September 1992.

As mentioned earlier, one of the assumptions of the original method is migration of the children. The movements of the children after birth were not taken into consideration. The questionnaire of the 1993 TDHS allows redefining the regions according to the region where the children were born. Two different d(a) values were calculated for two different region definition of 1993 TDHS. The first region definition was made according to the region where the children live now, and the other definition is according to the region where the children were born. When these values were compared, there are some differences in proportions for the same periods. The table below shows the unsmoothed d(a) values differences for regions. There is no possibility of calculating the proportions for 1978 TFS as 1993 TDHS. The regional proportions in 1978 TFS were computed according to the region definition as in the original method. But the proportions for 1993 TDHS were calculated through the information of children's birthplace. Therefore, there was no need for any migration assumption for 1993 TDHS.

TABLE 2.3.1 d(a) DIFFERENCES FOR TWO REGION DEFINITIONS FOR 1993 TDHS

| PERIOD | WEST | SOUTH | CENTRE | NORTH | EAST |
|---|---|---|---|---|---|
| 93-91 | 0.000 | 0.000 | -0.003 | 0.000 | 0.003 |
| 91-89 | 0.001 | 0.005 | -0.002 | 0.000 | -0.004 |
| 89-87 | 0.003 | -0.002 | -0.001 | 0.000 | 0.003 |
| 87-85 | -0.002 | -0.001 | 0.000 | 0.007 | 0.002 |
| 85-83 | 0.017 | -0.001 | 0.003 | -0.018 | -0.001 |
| 83-81 | 0.018 | 0.003 | -0.016 | 0.005 | -0.007 |
| 81-79 | 0.009 | 0.010 | -0.008 | -0.003 | -0.005 |
| 79-77 | 0.010 | 0.002 | -0.005 | 0.000 | -0.007 |
| 77-75 | 0.014 | 0.008 | -0.014 | 0.000 | 0.001 |
| 75-73 | 0.018 | 0.009 | 0.001 | -0.015 | 0.001 |
| 73-71 | 0.008 | 0.014 | -0.004 | -0.007 | -0.015 |
| 71-69 | 0.043 | -0.016 | 0.000 | -0.022 | -0.002 |
| 69-67 | -0.008 | -0.020 | 0.007 | -0.008 | 0.062 |

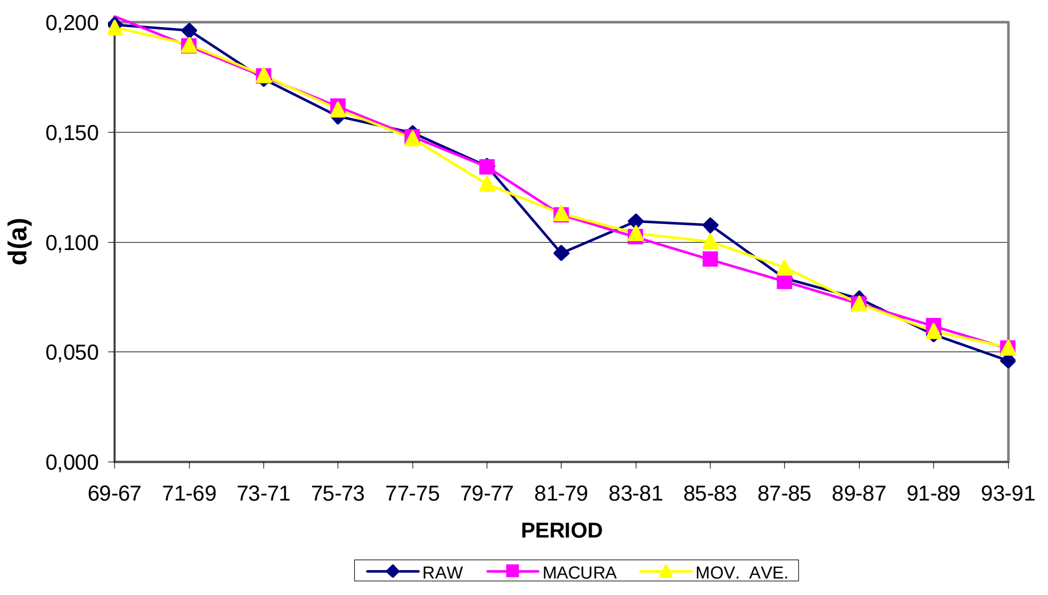
The most significant change for estimating the trends from the original method was the use of a different smoothing process. As mentioned in the previous chapters, in the original method, the purpose of the smoothing process of the cohort proportions is to keep the unity between proportions by drawing best lines. Most of the time, in order to reach the unity, an exact linear relationship was assumed between proportions of different periods. This smoothing process results in linear trends for estimations but it is not possible to control or to see the real fluctuations or real changes in the mortality trends.

The raw proportions were smoothed with using “Moving Averages” function in Harvard Graphics (Dos ver 3.0) package. This function is generally used for smoothing time series. The power of the function can be arranged by the user. Here the power means the degree of the proportions that were used in the calculations. The process of the function works as follows: If the function is defined as 1 by 1, then the average of the two consecutive proportions is taken. If the power is defined as 1 by 2. Then the function takes the averages of the former and the two latter proportions. Smoothing function assumes each cohort proportion as one series and smoothes the proportions as defined. The purpose of the smoothing process is to keep the general shape of the mortality trend when it is compared to the estimation process of the original method. Figure 2.3.2. shows the raw; and the smoothed d(a) values. Although, the raw values are not problematic values, it can be seen that it consists of two linear lines. Moving averages smoothes the raw data but fluctuations in the periods 85-83 and 79-77 are still, remaining. The smoothing process of Macura was illustrated in the Table 2.3.2. both sexes for 1993 TDHS. The power of the moving averages function was taken as (1,1) for 1993 TDHS and (1,2) for 1978 TFS. The raw proportions of the 1978 TFS fluctuated more than that of 1993 TDHS. The power of the function might be put higher for TFS, but in many case it would also approaches to linear line. Hence, the definition (1,2) was used for the power of the function.

TABLE 2.3.2 MACURA'S ESTIMATION PROCEDURE AND COMPARISON WITH MOVING AVERAGES (1993 TDHS, BOTH SEXES)

| PERIOD | T | S | D | RAW d | d'1 | d'2 | | D'1 | D'2 | MACURA d' | MOV. AVE. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 93-91 | 1585 | 1512 | 73 | 0.046 | 0.052 | | | 82 | | 0.052 | 0.052 |
| 91-89 | 1467 | 1382 | 85 | 0.058 | 0.062 | | | 91 | | 0.062 | 0.059 |
| 89-87 | 1549 | 1434 | 115 | 0.074 | 0.072 | | | 111 | | 0.072 | 0.072 |
| 87-85 | 1783 | 1634 | 149 | 0.084 | 0.082 | | | 146 | | 0.082 | 0.088 |
| 85-83 | 1831 | 1634 | 197 | 0.108 | 0.092 | | | 166 | | 0.092 | 0.100 |
| 83-81 | 1818 | 1619 | 199 | 0.109 | 0.102 | | | 184 | | 0.102 | 0.104 |
| 81-79 | 1873 | 1695 | 178 | 0.095 | 0.112 | | | 215 | | 0.112 | 0.113 |
| 79-77 | 1680 | 1454 | 226 | 0.135 | | 0.134 | | | 225 | 0.134 | 0.126 |
| 77-75 | 1531 | 1302 | 229 | 0.150 | | 0.148 | | | 226 | 0.148 | 0.147 |
| 75-73 | 1291 | 1088 | 203 | 0.157 | | 0.162 | | | 210 | 0.162 | 0.160 |
| 73-71 | 1108 | 915 | 193 | 0.174 | | 0.175 | | | 195 | 0.175 | 0.176 |
| 71-69 | 912 | 733 | 179 | 0.196 | | 0.189 | | | 171 | 0.189 | 0.190 |
| 69-67 | 628 | 503 | 125 | 0.199 | | 0.203 | | | 128 | 0.203 | 0.198 |
| | | | | | | | D' | 995 | 1154 | | |
| | | | | | | | D | 996 | 1155 | | |
| | | | | | | | | 0.998 | 0.999 | | |

**FIGURE 2.3.2. COMPARISON OF d(a) VALUES OF TWO DIFFERENT SMOOTHING PROCESSES FOR BOTH SEXES (1993 TDHS)**




The raw and smoothed proportions are illustrated in the following tables :

TABLE 2.3.3.1978 TFS, RAW AND SMOOTHED d PROPORTIONS

| | TOTAL | | MALE | | FEMALE | |
|---|---|---|---|---|---|---|
| | RAW | SMOOTHED | RAW | SMOOTHED | RAW | SMOOTHED |
| 78-76 | 0.10007 | 0.13203 | 0.10240 | 0.13761 | 0.09759 | 0.12659 |
| 76-74 | 0.16399 | 0.14776 | 0.17282 | 0.15154 | 0.15558 | 0.14408 |
| 74-72 | 0.17924 | 0.15896 | 0.17940 | 0.16105 | 0.17907 | 0.15701 |
| 72-70 | 0.19256 | 0.17985 | 0.18956 | 0.18122 | 0.19581 | 0.17865 |
| 70-68 | 0.18363 | 0.19296 | 0.18312 | 0.18873 | 0.18414 | 0.19736 |
| 68-66 | 0.21641 | 0.20267 | 0.20286 | 0.19614 | 0.23043 | 0.20927 |
| 66-64 | 0.21809 | 0.21254 | 0.20902 | 0.20167 | 0.22668 | 0.22357 |
| 64-62 | 0.23202 | 0.23637 | 0.21168 | 0.22999 | 0.25301 | 0.24277 |
| 62-60 | 0.27897 | 0.25745 | 0.29642 | 0.25696 | 0.26094 | 0.25790 |
| 60-58 | 0.30071 | 0.28997 | 0.31071 | 0.30714 | 0.29094 | 0.27132 |
| 58-56 | 0.34817 | 0.31086 | 0.40977 | 0.33110 | 0.28037 | 0.28946 |
| 56-54 | 0.31558 | 0.31554 | 0.30751 | 0.33873 | 0.32558 | 0.29146 |
| 54-52 | 0.29771 | 0.32049 | 0.32692 | 0.34807 | 0.26894 | 0.29163 |

TABLE 2.3.4.1993 TDHS, RAW AND SMOOTHED d PROPORTIONS

| | TOTAL | | MALE | | FEMALE | |
|---|---|---|---|---|---|---|
| | RAW | SMOOTHED | RAW | SMOOTHED | RAW | SMOOTHED |
| 93-91 | 0.04606 | 0.05200 | 0.05066 | 0.05115 | 0.04101 | 0.05265 |
| 91-89 | 0.05794 | 0.05941 | 0.05163 | 0.06201 | 0.06430 | 0.05646 |
| 89-87 | 0.07424 | 0.07192 | 0.08375 | 0.07228 | 0.06409 | 0.07135 |
| 87-85 | 0.08357 | 0.08847 | 0.08147 | 0.09427 | 0.08568 | 0.08211 |
| 85-83 | 0.10759 | 0.10021 | 0.11759 | 0.10526 | 0.09655 | 0.09458 |
| 83-81 | 0.10946 | 0.10403 | 0.11672 | 0.11533 | 0.10150 | 0.09166 |
| 81-79 | 0.09504 | 0.11301 | 0.11168 | 0.12658 | 0.07692 | 0.09845 |
| 79-77 | 0.13452 | 0.12638 | 0.15134 | 0.13989 | 0.11693 | 0.11191 |
| 77-75 | 0.14958 | 0.14711 | 0.15664 | 0.16031 | 0.14188 | 0.13360 |
| 75-73 | 0.15724 | 0.16034 | 0.17296 | 0.17237 | 0.14199 | 0.14815 |
| 73-71 | 0.17419 | 0.17590 | 0.18750 | 0.18627 | 0.16058 | 0.16547 |
| 71-69 | 0.19627 | 0.18984 | 0.19836 | 0.19680 | 0.19385 | 0.18273 |
| 69-67 | 0.19905 | 0.19766 | 0.20455 | 0.20145 | 0.19375 | 0.19380 |

TABLE 2.3.5.1978 TFS, RAW AND SMOOTHED d PROPORTIONS BY REGION

| | WEST | | SOUTH | | CENTRE | | NORTH | | EAST | |
|---|---|---|---|---|---|---|---|---|---|---|
| PERIOD | RAW | SMOOTHED | RAW | SMOOTHED | RAW | SMOOTHED | RAW | SMOOTHED | RAW | SMOOTHED |
| **78-76** | 0.11050 | 0.11289 | 0.06878 | 0.10384 | 0.10633 | 0.14431 | 0.09360 | 0.13205 | 0.10256 | 0.14847 |
| **76-74** | 0.11527 | 0.12753 | 0.13889 | 0.12315 | 0.18229 | 0.16007 | 0.17051 | 0.14944 | 0.19438 | 0.16216 |
| **74-72** | 0.15681 | 0.12562 | 0.16177 | 0.13196 | 0.19159 | 0.17698 | 0.18421 | 0.16435 | 0.18954 | 0.17758 |
| **72-70** | 0.11989 | 0.13565 | 0.15842 | 0.14443 | 0.22770 | 0.20240 | 0.20909 | 0.18136 | 0.22385 | 0.20950 |
| **70-68** | 0.15065 | 0.15618 | 0.11864 | 0.14542 | 0.20800 | 0.21336 | 0.16162 | 0.19320 | 0.23022 | 0.22390 |
| **68-66** | 0.19737 | 0.15279 | 0.14286 | 0.14089 | 0.22616 | 0.23183 | 0.21788 | 0.22417 | 0.25201 | 0.23466 |
| **66-64** | 0.14325 | 0.16392 | 0.14365 | 0.15563 | 0.26546 | 0.23724 | 0.30811 | 0.22190 | 0.23256 | 0.25210 |
| **64-62** | 0.16443 | 0.19024 | 0.21739 | 0.18097 | 0.24934 | 0.26094 | 0.20000 | 0.24165 | 0.29361 | 0.27570 |
| **62-60** | 0.25589 | 0.20533 | 0.22000 | 0.21737 | 0.30278 | 0.28342 | 0.24060 | 0.24352 | 0.32463 | 0.30708 |
| **60-58** | 0.25773 | 0.22713 | 0.28846 | 0.27762 | 0.31609 | 0.31023 | 0.22535 | 0.25425 | 0.37751 | 0.36257 |
| **58-56** | 0.23047 | 0.24527 | 0.38462 | 0.27188 | 0.37269 | 0.33870 | 0.35106 | 0.29056 | 0.45455 | 0.38532 |
| **56-54** | 0.23697 | 0.25083 | 0.19444 | 0.26376 | 0.36325 | 0.35133 | 0.34524 | 0.28250 | 0.38462 | 0.38599 |
| **54-52** | 0.27815 | 0.24853 | 0.18750 | 0.25552 | 0.35329 | 0.36308 | 0.20833 | 0.30155 | 0.32727 | 0.38881 |

TABLE 2.3.6. 1993 TDHS, RAW AND SMOOTHED d PROPORTIONS BY REGION

| | WEST | | SOUTH | | CENTRE | | NORTH | | EAST | |
|---|---|---|---|---|---|---|---|---|---|---|
| PERIOD | RAW | SMOOTHED | RAW | SMOOTHED | RAW | SMOOTHED | RAW | SMOOTHED | RAW | SMOOTHED |
| **93-91** | 0.03254 | 0.04503 | 0.05112 | 0.05437 | 0.06017 | 0.05896 | 0.04598 | 0.04053 | 0.04012 | 0.05814 |
| **91-89** | 0.05751 | 0.04373 | 0.05763 | 0.06189 | 0.05775 | 0.07178 | 0.03509 | 0.04740 | 0.07616 | 0.06820 |
| **89-87** | 0.04114 | 0.05255 | 0.07692 | 0.07152 | 0.09742 | 0.07944 | 0.06114 | 0.06463 | 0.08833 | 0.08742 |
| **87-85** | 0.05899 | 0.05652 | 0.08000 | 0.08602 | 0.08314 | 0.09607 | 0.09766 | 0.09612 | 0.09778 | 0.10581 |
| **85-83** | 0.06944 | 0.06937 | 0.10112 | 0.09040 | 0.10766 | 0.10526 | 0.12957 | 0.10918 | 0.13131 | 0.12422 |
| **83-81** | 0.07967 | 0.07630 | 0.09009 | 0.08415 | 0.12500 | 0.11387 | 0.10032 | 0.11298 | 0.14356 | 0.12960 |
| **81-79** | 0.07980 | 0.09041 | 0.06122 | 0.08829 | 0.10896 | 0.12667 | 0.10903 | 0.11792 | 0.11392 | 0.13749 |
| **79-77** | 0.11177 | 0.10134 | 0.11357 | 0.10069 | 0.14604 | 0.14699 | 0.14440 | 0.13745 | 0.15497 | 0.14220 |
| **77-75** | 0.11246 | 0.10844 | 0.12727 | 0.11620 | 0.18598 | 0.17128 | 0.15892 | 0.17694 | 0.15772 | 0.16253 |
| **75-73** | 0.10108 | 0.12089 | 0.10776 | 0.13115 | 0.18182 | 0.18082 | 0.22749 | 0.18853 | 0.17491 | 0.18130 |
| **73-71** | 0.14912 | 0.13717 | 0.15842 | 0.13607 | 0.17466 | 0.19717 | 0.17919 | 0.19763 | 0.21127 | 0.21060 |
| **71-69** | 0.16129 | 0.15767 | 0.14205 | 0.15773 | 0.23504 | 0.21894 | 0.18621 | 0.17107 | 0.24561 | 0.23406 |
| **69-67** | 0.16260 | 0.16195 | 0.17273 | 0.15739 | 0.24713 | 0.24108 | 0.14783 | 0.16702 | 0.24528 | 0.24545 |

The calculations of the estimates for both sexes were done by combining the results of males and females. The sex ratio of 1.05 stated in the source book is utilized in the computations of the estimates for both sexes. The direct calculation of the estimates from total d(a) values did not give different results from calculations after combining the male and female results through the use of ratio 1.05.

Except for the estimations based on the 1978 TFS with Chilean pattern, other calculations for both sexes were carried out by combining the results. Since the male proportions for some periods in 1978 are not convenient to use with Chilean pattern, the estimates for this case were obtained directly from proportions for both sexes. The table below shows the sex ratios of respective periods in this study.

TABLE 2.3.7. SEX RATIOS OF TWO YEAR PERIODS

| | 1993 | | | 1978 | | |
|---|---|---|---|---|---|---|
| a | MALE | FEMALE | SR 1993 | MALE | FEMALE | SR 1978 |
| 2 | 829 | 756 | 1.10 | 791 | 748 | 1.06 |
| 4 | 736 | 731 | 1.01 | 758 | 797 | 0.95 |
| 6 | 800 | 749 | 1.07 | 864 | 793 | 1.09 |
| 8 | 896 | 887 | 1.01 | 881 | 812 | 1.08 |
| 10 | 961 | 870 | 1.10 | 770 | 782 | 0.98 |
| 12 | 951 | 867 | 1.10 | 700 | 677 | 1.03 |
| 14 | 976 | 897 | 1.09 | 732 | 772 | 0.95 |
| 16 | 859 | 821 | 1.05 | 685 | 664 | 1.03 |
| 18 | 798 | 733 | 1.09 | 614 | 594 | 1.03 |
| 20 | 636 | 655 | 0.97 | 560 | 574 | 0.98 |
| 22 | 560 | 548 | 1.02 | 471 | 428 | 1.10 |
| 24 | 489 | 423 | 1.16 | 426 | 344 | 1.24 |
| 26 | 308 | 320 | 0.96 | 260 | 264 | 0.98 |
| 28 | 452 | 412 | 1.10 | 332 | 303 | 1.10 |
| TOTAL | 10251 | 9669 | 1.06 | 8844 | 8552 | 1.03 |

The number of children born for the periods of the study were given in the below tables.

TABLE 2.3.8.1978 TFS, NUMBER OF CHILDREN BORN FOR DEFINED PERIODS BY SEX AND REGIONS

| PERIOD | MALE | FEMALE | WEST | SOUTH | CENTRE | NORTH | EAST | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 1978-76 | 791 | 748 | 362 | 189 | 395 | 203 | 390 | 1539 |
| 1976-74 | 758 | 797 | 347 | 180 | 384 | 217 | 427 | 1555 |
| 1974-72 | 864 | 793 | 338 | 204 | 428 | 228 | 459 | 1657 |
| 1972-70 | 881 | 812 | 367 | 202 | 426 | 220 | 478 | 1693 |
| 1970-68 | 770 | 782 | 385 | 177 | 375 | 198 | 417 | 1552 |
| 1968-66 | 700 | 677 | 304 | 154 | 367 | 179 | 373 | 1377 |
| 1966-64 | 732 | 772 | 363 | 181 | 388 | 185 | 387 | 1504 |
| 1964-62 | 685 | 664 | 298 | 161 | 381 | 165 | 344 | 1349 |
| 1962-60 | 614 | 594 | 297 | 150 | 360 | 133 | 268 | 1208 |
| 1960-58 | 560 | 574 | 291 | 104 | 348 | 142 | 249 | 1134 |
| 1958-56 | 471 | 428 | 256 | 91 | 271 | 94 | 187 | 899 |
| 1956-54 | 426 | 344 | 211 | 72 | 234 | 84 | 169 | 770 |
| 1954-52 | 260 | 264 | 151 | 48 | 167 | 48 | 110 | 524 |
| 1952- | 332 | 303 | 171 | 68 | 200 | 65 | 131 | 635 |
| TOTAL | 8844 | 8552 | 4141 | 1981 | 4724 | 2161 | 4389 | 17396 |

TABLE 2.3.9 1993 TDHS, NUMBER OF CHILDREN BORN FOR DEFINED PERIODS BY SEX AND REGIONS

| PERIOD | TOTAL | MALE | FEMALE | WEST | SOUTH | CENTRE | NORTH | EAST |
|---|---|---|---|---|---|---|---|---|
| 1993-91 | 1591 | 832 | 759 | 338 | 313 | 349 | 261 | 324 |
| 1991-89 | 1471 | 737 | 734 | 313 | 295 | 329 | 228 | 302 |
| 1989-87 | 1554 | 804 | 750 | 316 | 338 | 349 | 229 | 317 |
| 1987-85 | 1789 | 899 | 890 | 356 | 300 | 421 | 256 | 450 |
| 1985-83 | 1841 | 966 | 875 | 360 | 356 | 418 | 301 | 396 |
| 1983-81 | 1839 | 960 | 879 | 364 | 333 | 408 | 309 | 404 |
| 1981-79 | 1896 | 989 | 907 | 401 | 343 | 413 | 321 | 395 |
| 1979-77 | 1704 | 870 | 834 | 340 | 317 | 404 | 277 | 342 |
| 1977-75 | 1556 | 810 | 746 | 329 | 275 | 371 | 258 | 298 |
| 1975-73 | 1310 | 646 | 664 | 277 | 232 | 308 | 211 | 263 |
| 1973-71 | 1125 | 573 | 552 | 228 | 202 | 292 | 173 | 213 |
| 1971-69 | 921 | 494 | 427 | 186 | 176 | 234 | 145 | 171 |
| 1969-67 | 630 | 309 | 321 | 123 | 110 | 174 | 115 | 106 |
| 1967- | 866 | 452 | 414 | 183 | 127 | 233 | 171 | 150 |
| TOTAL | 20093 | 10341 | 9752 | 4114 | 3717 | 4703 | 3255 | 4131 |

## 2.4 AN EXAMPLE FOR THE ESTIMATION PROCESS OF THE TECHNIQUE (1993 TDHS MALES with EAST MODEL)

In order to understand the estimation process of the technique, a detailed example would be very helpful. In this example, the estimation of infant mortality and under-five mortality rates of the males from 1993 TDHS are illustrated. The Coale-Demeny East model was the selected model life table system for necessary calculations.

Firstly, the proportion of deceased children for all two-year cohorts was calculated. Accordingly, a smoothing process was applied to the data due to fact that the raw data of the surveys, 1978 and 1993, were not used in this study. The next step of the calculations is the smoothing process of the data. For this purpose the raw proportions were smoothed by using moving averages function in Harvard Graphics package.

For the estimation process an Excel spreadsheet was prepared that makes all necessary calculations possible. The file consists of three parts. First part of file is used to calculate the required $l_x$ values for all levels of the given life tables. In each file related life table values are entered into the file as a matrix (Table. 3.4.1), further to this a new matrix is computed for all odd x values up to age 25. This new matrix gives the $l_x$ values for all odd ages up to 25 and ${}_1q_0$ and ${}_5q_0$ values for the respective life table model (Table 3.4.2.). Here, x takes values as 1,3,5,7, …., 25.

TABLE 2.4.1 lx VALUES

| | level | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 1 | 0.80562 | 0.82416 | 0.84204 | 0.85923 | 0.87574 | 0.89158 | 0.90672 | 0.92117 | 0.93494 | 0.94857 | 0.96108 | 0.97240 | 0.98218 |
| 3 | 0.75797 | 0.78201 | 0.80516 | 0.82742 | 0.84879 | 0.86933 | 0.88918 | 0.90827 | 0.92637 | 0.94271 | 0.95738 | 0.97029 | 0.98115 |
| 5 | 0.74259 | 0.76841 | 0.79326 | 0.81715 | 0.84009 | 0.86214 | 0.88329 | 0.90357 | 0.92300 | 0.94023 | 0.95571 | 0.96928 | 0.98064 |
| 10 | 0.75523 | 0.75256 | 0.77896 | 0.80443 | 0.82896 | 0.85259 | 0.87533 | 0.89718 | 0.91818 | 0.93649 | 0.95308 | 0.96759 | 0.97967 |
| 15 | 0.71610 | 0.74398 | 0.77097 | 0.79705 | 0.82224 | 0.84655 | 0.86997 | 0.89252 | 0.91422 | 0.93325 | 0.95056 | 0.96576 | 0.97847 |
| 20 | 0.70170 | 0.73027 | 0.75802 | 0.78494 | 0.81101 | 0.83625 | 0.86064 | 0.88417 | 0.90688 | 0.92710 | 0.94562 | 0.96200 | 0.97584 |
| 25 | 0.68120 | 0.71073 | 0.73955 | 0.76763 | 0.79495 | 0.82151 | 0.84728 | 0.87223 | 0.89638 | 0.91834 | 0.93857 | 0.95665 | 0.97120 |
| 1q0 | 0.19438 | 0.17584 | 0.15796 | 0.14077 | 0.12426 | 0.10842 | 0.09328 | 0.07883 | 0.06506 | 0.05143 | 0.03892 | 0.02760 | 0.01782 |

TABLE 2.4.2 lx VALUES OF ODD AGES UP TO 25

| age | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.80562 | 0.82416 | 0.84204 | 0.85923 | 0.87574 | 0.89158 | 0.90672 | 0.92117 | 0.93494 | 0.94857 | 0.96108 | 0.97240 | 0.98218 |
| 3 | 0.75797 | 0.78201 | 0.80516 | 0.82742 | 0.84879 | 0.86933 | 0.88918 | 0.90827 | 0.92637 | 0.94271 | 0.95738 | 0.97029 | 0.98115 |
| 5 | 0.74259 | 0.76841 | 0.79326 | 0.81715 | 0.84009 | 0.86214 | 0.88329 | 0.90357 | 0.92300 | 0.94023 | 0.95571 | 0.96928 | 0.98064 |
| 7 | 0.74765 | 0.76207 | 0.78754 | 0.81206 | 0.83564 | 0.85832 | 0.88011 | 0.90101 | 0.92107 | 0.93873 | 0.95466 | 0.96860 | 0.98025 |
| 9 | 0.75270 | 0.75573 | 0.78182 | 0.80697 | 0.83119 | 0.85450 | 0.87692 | 0.89846 | 0.91914 | 0.93724 | 0.95361 | 0.96793 | 0.97986 |
| 11 | 0.74740 | 0.75084 | 0.77736 | 0.80295 | 0.82762 | 0.85138 | 0.87426 | 0.89625 | 0.91739 | 0.93584 | 0.95258 | 0.96722 | 0.97943 |
| 13 | 0.73175 | 0.74741 | 0.77417 | 0.80000 | 0.82493 | 0.84897 | 0.87211 | 0.89438 | 0.91580 | 0.93455 | 0.95157 | 0.96649 | 0.97895 |
| 15 | 0.71610 | 0.74398 | 0.77097 | 0.79705 | 0.82224 | 0.84655 | 0.86997 | 0.89252 | 0.91422 | 0.93325 | 0.95056 | 0.96576 | 0.97847 |
| 17 | 0.71034 | 0.73850 | 0.76579 | 0.79221 | 0.81775 | 0.84243 | 0.86624 | 0.88918 | 0.91128 | 0.93079 | 0.94858 | 0.96426 | 0.97742 |
| 19 | 0.70458 | 0.73301 | 0.76061 | 0.78736 | 0.81326 | 0.83831 | 0.86251 | 0.88584 | 0.90835 | 0.92833 | 0.94661 | 0.96275 | 0.97637 |
| 21 | 0.69760 | 0.72636 | 0.75433 | 0.78148 | 0.80780 | 0.83330 | 0.85797 | 0.88178 | 0.90478 | 0.92535 | 0.94421 | 0.96093 | 0.97491 |
| 23 | 0.68940 | 0.71855 | 0.74694 | 0.77455 | 0.80137 | 0.82741 | 0.85262 | 0.87701 | 0.90058 | 0.92184 | 0.94139 | 0.95879 | 0.97306 |
| 25 | 0.68120 | 0.71073 | 0.73955 | 0.76763 | 0.79495 | 0.82151 | 0.84728 | 0.87223 | 0.89638 | 0.91834 | 0.93857 | 0.95665 | 0.97120 |
| Level | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 1q0 | 0.19438 | 0.17584 | 0.15796 | 0.14077 | 0.12426 | 0.10842 | 0.09328 | 0.07883 | 0.06506 | 0.05143 | 0.03892 | 0.02760 | 0.01782 |
| 5q0 | 0.25741 | 0.23159 | 0.20674 | 0.18285 | 0.15991 | 0.13786 | 0.11671 | 0.09643 | 0.07700 | 0.05977 | 0.04429 | 0.03072 | 0.01936 |

Then, the second part of the file works for the computation of the life table equation system. As mentioned in section 3.2.2., there is an equation showing a relationship that exists between a cohort proportion of deceased children and the cohort's probabilities of surviving through the years between birth and end of t=0.

In this equation system, d(t) values are known. The unknown values are the life table values. If we apply the estimation procedure, we can reach the unknown values one by one and solve the equation system step by step. The solution of the equation system works as a chain of equations and unknown and known values.

In the second part of the file we have again two matrices, first matrix (Table 3.4.3) is half-diagonal one and it is the formulated form of the equation system. In this matrix the solution of the each step of the estimation procedures occur, this matrix always do its calculations in relation to the other matrix (Table 3.4.4) that is the new constructed life table matrix for each cohort.

It is more explanatory to tell the steps of the estimation procedure with real example values. We have d(t) values of males from 1993 TDHS and we have used East model as base life table model. We have reached all $l_x$ values for odd ages up to age 25 for levels of east model for male in our second matrix.

We have d(1) = 0.05115 for t =1, then our $(l_1)_1$ value is 1-d(1)=0.94885 which stands between the east model levels 21 and 22. By interpolating the $l_1$ value we have a new life table column, whose level is 21,02 and stands for t =1. The value of ${}_1q_0$ which is 0.05115 in the new column is our infant mortality rate estimation for t =1(period 1991-1993), and the value of ${}_5q_0$ which is 0.05942 in the new column is our under-five mortality rate estimation for the same period.

The second d(t) value that is d(2)=0.06201, was used to calculate the second column of the life table column for t=2. Every step of the estimation procedure needs the some values of previous steps. Here, $(l_3/l_1)_1$ value were computed as 0.99388 from the life table column for t=1 where $l_1$ =0.94885 and $l_3$=0.94304. Then $(l_1)_2$ was found as 0.94377 from the formula:

$$d(2)= 1 - (l_3/l_1)_1 * (l_1)_2$$

In order to construct the life table column for t=2, l values were interpolated between levels 20 and 21. The new column has a level of 20.65 that estimates the infant mortality rate as 0.05623 and under-five mortality rate as 0.06584 for period 1991-1989.

In the next step, calculations were done in order to construct the life table column for t=3 and of course, the life table values for t=1 and t=2 are required to solve equations. For calculating the $(l_1)_3$ value, $(l_3/l_1)_2$ value is required from life table column for t=2 and $(l_5/l_3)_1$ value is required from the life table column for t=1. In this case $(l_3/l_1)_2$ is 0.99278 and $(l_5/l_3)_1$ is 0.99739. Then, $(l_1)_3$ was calculated as 0.93691 from the formula:

$$d(3)= 1- (l_1)_3 * (l_3/l_1)_2 * (l_5/l_3)_1$$

When the interpolation was applied, the level of the new life table column for t=3 was found as 20.14 where the infant mortality rate estimation is 0.06309 and under-five mortality rate estimation for t=3 (period 1989-1987).

This estimation procedure works up to last cohort where t=13 and at the end we have a new matrix that consists of life table values constructed for different t values. The level of the table and related mortality rates can be calculated from this matrix. During the calculations, for every column of the matrix, the life table values of the previous ones were used. For example for the last column (ie. t=13), every column of the matrix gave some value to reach $(l_1)_{13}$ value.

The last part of the file just shows the results of the calculations, again this is a matrix that summaries the results of the estimations. (Table 3.4.5.)

TABLE 2.4.3 CALCULATION MATRIX OF THE METHOD

| Time | t | d(t) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 93-91 | 1 | 0.05115 | 0.94885 | | | | | | | | | | | | |
| 91-89 | 2 | 0.06201 | 0.99388 | 0.94377 | | | | | | | | | | | |
| 89-87 | 3 | 0.07228 | 0.99739 | 0.99278 | 0.93691 | | | | | | | | | | |
| 87-85 | 4 | 0.09427 | 0.99842 | 0.99702 | 0.99127 | 0.91789 | | | | | | | | | |
| 85-83 | 5 | 0.10526 | 0.99842 | 0.99824 | 0.99651 | 0.98480 | 0.91479 | | | | | | | | |
| 83-81 | 6 | 0.11533 | 0.99852 | 0.99823 | 0.99798 | 0.99450 | 0.98366 | 0.90912 | | | | | | | |
| 81-79 | 7 | 0.12658 | 0.99862 | 0.99836 | 0.99798 | 0.99700 | 0.99419 | 0.98155 | 0.90226 | | | | | | |
| 79-77 | 8 | 0.13989 | 0.99862 | 0.99850 | 0.99815 | 0.99699 | 0.99683 | 0.99362 | 0.97902 | 0.89389 | | | | | |
| 77-75 | 9 | 0.16031 | 0.99738 | 0.99849 | 0.99832 | 0.99741 | 0.99682 | 0.99653 | 0.99290 | 0.97591 | 0.87972 | | | | |
| 75-73 | 10 | 0.17237 | 0.99737 | 0.99716 | 0.99832 | 0.99784 | 0.99729 | 0.99651 | 0.99616 | 0.99199 | 0.97071 | 0.87631 | | | |
| 73-71 | 11 | 0.18627 | 0.99680 | 0.99716 | 0.99687 | 0.99783 | 0.99776 | 0.99706 | 0.99614 | 0.99570 | 0.99026 | 0.96944 | 0.86885 | | |
| 71-69 | 12 | 0.19680 | 0.99623 | 0.99654 | 0.99686 | 0.99614 | 0.99775 | 0.99761 | 0.99679 | 0.99568 | 0.99492 | 0.98982 | 0.96665 | 0.86635 | |
| 69-67 | 13 | 0.20145 | 0.99622 | 0.99592 | 0.99618 | 0.99612 | 0.99602 | 0.99760 | 0.99744 | 0.99645 | 0.99490 | 0.99473 | 0.98886 | 0.96570 | 0.86905 |

TABLE 2.4.4 LIFE TABLE lx MATRIX FOR PERIODS

| | level | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 1 | 0.94885 | 0.94377 | 0.93691 | 0.91789 | 0.91479 | 0.90912 | 0.90226 | 0.89389 | 0.87972 | 0.87631 | 0.86885 | 0.86635 | 0.86905 |
| 3 | 0.94304 | 0.93695 | 0.92873 | 0.90394 | 0.89985 | 0.89235 | 0.88333 | 0.87236 | 0.85395 | 0.84954 | 0.83987 | 0.83663 | 0.84013 |
| 5 | 0.94058 | 0.93416 | 0.92549 | 0.89897 | 0.89462 | 0.88665 | 0.87706 | 0.86537 | 0.84563 | 0.84089 | 0.83052 | 0.82704 | 0.83080 |
| 7 | 0.93909 | 0.93251 | 0.92362 | 0.89627 | 0.89179 | 0.88357 | 0.87369 | 0.86165 | 0.84134 | 0.83646 | 0.82580 | 0.82223 | 0.82609 |
| 9 | 0.93761 | 0.93086 | 0.92176 | 0.89357 | 0.88895 | 0.88049 | 0.87032 | 0.85793 | 0.83704 | 0.83203 | 0.82108 | 0.81741 | 0.82138 |
| 11 | 0.93622 | 0.92934 | 0.92005 | 0.89125 | 0.88654 | 0.87790 | 0.86752 | 0.85488 | 0.83359 | 0.82848 | 0.81732 | 0.81359 | 0.81763 |
| 13 | 0.93493 | 0.92794 | 0.91851 | 0.88933 | 0.88456 | 0.87581 | 0.86530 | 0.85250 | 0.83097 | 0.82580 | 0.81452 | 0.81075 | 0.81483 |
| 15 | 0.93364 | 0.92654 | 0.91697 | 0.88740 | 0.88257 | 0.87371 | 0.86307 | 0.85013 | 0.82835 | 0.82312 | 0.81173 | 0.80791 | 0.81204 |
| 17 | 0.93119 | 0.92391 | 0.91410 | 0.88397 | 0.87906 | 0.87004 | 0.85923 | 0.84607 | 0.82395 | 0.81864 | 0.80709 | 0.80322 | 0.80740 |
| 19 | 0.92874 | 0.92129 | 0.91124 | 0.88054 | 0.87554 | 0.86638 | 0.85538 | 0.84201 | 0.81955 | 0.81417 | 0.80245 | 0.79853 | 0.80277 |
| 21 | 0.92578 | 0.91810 | 0.90775 | 0.87637 | 0.87127 | 0.86192 | 0.85070 | 0.83707 | 0.81420 | 0.80872 | 0.79681 | 0.79283 | 0.79714 |
| 23 | 0.92229 | 0.91435 | 0.90365 | 0.87147 | 0.86625 | 0.85667 | 0.84520 | 0.83126 | 0.80791 | 0.80232 | 0.79018 | 0.78612 | 0.79051 |
| 25 | 0.91880 | 0.91060 | 0.89955 | 0.86656 | 0.86122 | 0.85142 | 0.83969 | 0.82545 | 0.80162 | 0.79591 | 0.78355 | 0.77941 | 0.78388 |
| level | 21.02 | 20.65 | 20.14 | 18.77 | 18.56 | 18.17 | 17.71 | 17.15 | 16.25 | 16.04 | 15.58 | 15.43 | 15.59 |
| 1q0 | 0.05115 | 0.05623 | 0.06309 | 0.08211 | 0.08521 | 0.09088 | 0.09774 | 0.10611 | 0.12028 | 0.12369 | 0.13115 | 0.13365 | 0.13095 |
| 5q0 | 0.05942 | 0.06584 | 0.07451 | 0.10103 | 0.10538 | 0.11335 | 0.12294 | 0.13463 | 0.15437 | 0.15911 | 0.16948 | 0.17296 | 0.16920 |

TABLE .2.4.5. RESULT MATRIX

| male | 93-91 | 91-89 | 89-87 | 87-85 | 85-83 | 83-81 | 81-79 | 79-77 | 77-75 | 75-73 | 73-71 | 71-69 | 69-67 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1q0 | 0.05115 | 0.05623 | 0.06309 | 0.08211 | 0.08521 | 0.09088 | 0.09774 | 0.10611 | 0.12028 | 0.12369 | 0.13115 | 0.13365 | 0.13095 |
| 5q0 | 0.05942 | 0.06584 | 0.07451 | 0.10103 | 0.10538 | 0.11335 | 0.12294 | 0.13463 | 0.15437 | 0.15911 | 0.16948 | 0.17296 | 0.16920 |
| level | 21.02 | 20.65 | 20.14 | 18.77 | 18.56 | 18.17 | 17.71 | 17.15 | 16.25 | 16.04 | 15.58 | 15.43 | 15.59 |

# CHAPTER III

## APPLICATION OF MACURA'S METHOD TO THE 1978 TFS AND THE 1993 TDHS

In this chapter, the results of the application of the Macura's method to the 1978 TFS and the 1993 TDHS is presented. This application has a wider scope when compared the original one. Besides Infant Mortality Rate estimations, Under-five Mortality estimations are also calculated and presented.

Analyses were carried out with two main variables. These variables are sex of the children and geographic regions. The results for total Turkey were estimated as both sexes by combining the male and female estimations. The details of region variable and assumptions for combining process were mentioned in the previous chapter.

Turkey is best described by using a conventional regional breakdown of the country. Five regions (West, South, Centre, North and East) are distinguished, reflecting to some extent, differences in socioeconomic development levels and demographic conditions among sections of the country. The regional breakdown is frequently used for sampling and analysis purposes in social surveys. In this thesis this conventional region definition for Turkey were utilized.

Another task of this thesis is the selection of the suitable model for the calculations. In view of the discussion of the pattern of early age mortality of Turkey in second chapter, two empirical model life table systems were used. These two models are the Coale-Demeny East Model and United Nations Chilean pattern. As previous studies has showed, these two models are accepted to be the most appropriate models which give best fits to Turkish early age mortality pattern.

The mortality levels of each estimate that were calculated by using East model and the expectation of life at birth ($e_0$) values of each estimates that were calculated by using Chilean model are the other resulting valuable indicators of mortality in this study.

This chapter consists of two sections. Each section gives the estimates and trends of infant mortality rate and under-five mortality rate by using both models, East and Chilean, for two year periods prior to the survey date. The estimates go back 26 years with 13 periods. Some estimates can not be computed for some past periods of males, region centre and region east for 1978 TFS when Chilean pattern were used. Estimates were given for sexes, males and females and for regions; West, South, Centre, North and East. In addition to the infant mortality rate and under-five mortality rate estimates the east model life table level and the expectation of life at birth ($e_0$) values are also presented in the tables and figures.

## 3.1. INDIRECT ESTIMATES OF IMR AND U5MR FROM 1978 TFS

The IMR and U5MR estimates are very close for two alternative models. The estimates obtained from the Chilean Model are higher than that of the East Model. There is approximately 10 ‰ difference between model estimates for IMR (Table 3.1.1.) and this percentage is 6 ‰ for U5MR.

The variation available in the Chilean Model in the period close to the survey date is less than the one exists in the East Model. According to the Figure 3.1.1, the IMR and U5MR estimates converge expectably to each other for periods close to the survey date. The first IMR estimate for both sexes for the period 78-76 is 0.132. This is of course the same for both models, since it is the initial estimate. The estimates of IMR for the periods 76-74 and 74-72 have lower values than the initial estimate. The estimates for first four periods have a stable trend and it starts to decrease after 60-58. The IMR estimates drops from 210 ‰ in 60-58 to about 121 ‰ in 74-72 for both models.

The U5MR estimates have the same trend line with IMR. The lowest estimate of U5MR is 0.151 for 76-74 period with East model whereas it was estimated 0.165 with Chilean model. The highest estimate of U5MR is 290 per thousand for period 58-56. Level estimations were estimated about 16 to 11 during the whole estimation period.

Males have heavier mortality rates compared to the both sexes. The Chilean model did not provide estimations for periods before 1960. Due to required $e_0$ values for calculations are less than 35 years for those periods, calculations can not be done. The fluctuations in the estimates, when they were computed with Chilean are less than they are from computed with East, model (Figure 3.1.2).

The difference between estimates of two models is a little more than that is for both sexes. The IMR estimation is 138 ‰ and U5MR estimation is 170 ‰ for 78-76 period. The IMR estimations exceed 220 ‰ and U5MR estimations exceed 300 ‰ for last four periods. However, the estimations are very close to each others for those periods (Table 3.1.2.). Maximum estimated $e_0$ value is 52 years for males for 74-72 period.

The estimations for females are less fluctuated than the estimations for males. Only unexpected jump was occurred for period 58-56 with East model. The estimations of two models are very close each other. The U5MR estimates of both models go very parallel for close periods to the survey date.

IMR dropped from 0.179 in period 60-58 to 0.127 for females in period 78-76 (Table 3.1.3.) when Chilean model was used. U5MR was estimated as 0.261 for period 60-58 when East model was used. Figure 3.1.3. shows insignificant drop in 58-56 in East model estimates.

East level ranges between about 15.5 and 11 for females. The lowest $e_0$ estimation is 40.77 years for period 58-56.

TABLE 3.1.1. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR BOTH SEXES (1978 TFS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 78-76 | 0.132 | 0.132 | 0.175 | 0.168 | 14.82 | 51.76 |
| 76-74 | 0.115 | 0.130 | 0.151 | 0.165 | 15.88 | 52.11 |
| 74-72 | 0.121 | 0.123 | 0.160 | 0.155 | 15.49 | 53.43 |
| 72-70 | 0.137 | 0.145 | 0.182 | 0.186 | 14.51 | 49.28 |
| 70-68 | 0.141 | 0.153 | 0.188 | 0.198 | 14.21 | 47.76 |
| 68-66 | 0.143 | 0.154 | 0.191 | 0.199 | 14.10 | 47.68 |
| 66-64 | 0.148 | 0.158 | 0.200 | 0.206 | 13.74 | 46.84 |
| 64-62 | 0.167 | 0.179 | 0.226 | 0.236 | 12.64 | 43.22 |
| 62-60 | 0.177 | 0.189 | 0.240 | 0.252 | 12.09 | 41.48 |
| 60-58 | 0.207 | 0.210 | 0.283 | 0.284 | 10.50 | 38.00 |
| 58-56 | 0.199 | 0.214 | 0.271 | 0.290 | 10.98 | 37.38 |
| 56-54 | 0.201 | 0.198 | 0.275 | 0.266 | 10.79 | 39.92 |
| 54-52 | 0.197 | 0.195 | 0.268 | 0.261 | 11.06 | 40.51 |

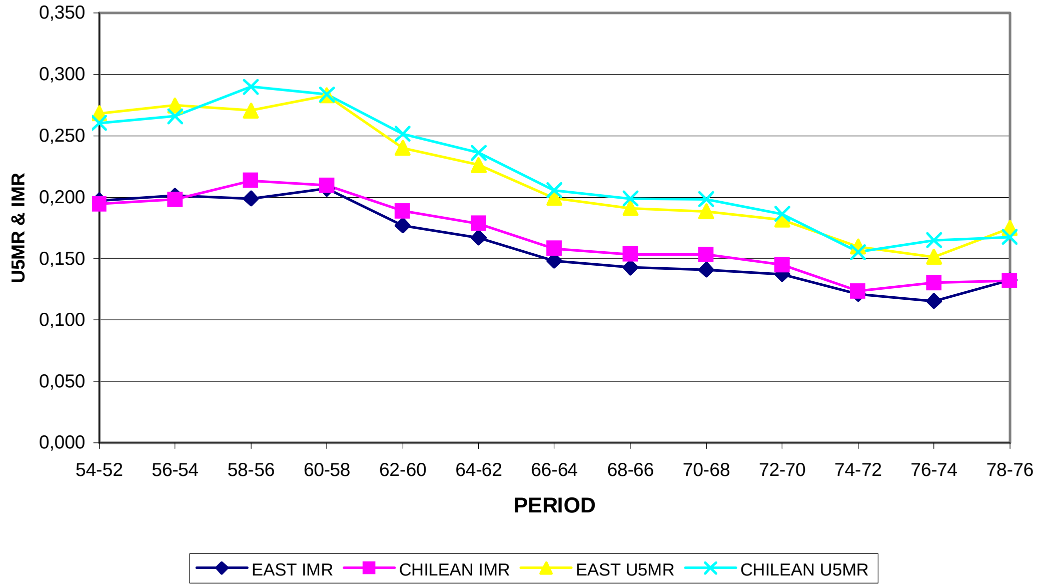
TABLE 3.1.2. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR MALES (1978 TFS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 78-76 | 0.138 | 0.138 | 0.178 | 0.170 | 15.19 | 50.35 |
| 76-74 | 0.120 | 0.136 | 0.154 | 0.168 | 16.27 | 50.64 |
| 74-72 | 0.125 | 0.129 | 0.161 | 0.158 | 15.93 | 51.88 |
| 72-70 | 0.141 | 0.151 | 0.184 | 0.188 | 14.96 | 48.09 |
| 70-68 | 0.139 | 0.156 | 0.180 | 0.195 | 15.11 | 47.35 |
| 68-66 | 0.142 | 0.156 | 0.185 | 0.196 | 14.91 | 47.25 |
| 66-64 | 0.144 | 0.158 | 0.187 | 0.198 | 14.82 | 47.01 |
| 64-62 | 0.170 | 0.184 | 0.223 | 0.234 | 13.33 | 42.88 |
| 62-60 | 0.185 | 0.201 | 0.244 | 0.259 | 12.52 | 40.27 |
| 60-58 | 0.227 | | 0.303 | | 10.35 | |
| 58-56 | 0.230 | | 0.307 | | 10.22 | |
| 56-54 | 0.223 | | 0.298 | | 10.54 | |
| 54-52 | 0.226 | | 0.302 | | 10.40 | |

TABLE 3.1.3. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR FEMALES (1978 TFS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 78-76 | 0.127 | 0.127 | 0.171 | 0.164 | 14.42 | 53.54 |
| 76-74 | 0.110 | 0.116 | 0.149 | 0.148 | 15.48 | 55.98 |
| 74-72 | 0.117 | 0.124 | 0.158 | 0.160 | 15.02 | 54.21 |
| 72-70 | 0.133 | 0.141 | 0.180 | 0.186 | 14.03 | 50.48 |
| 70-68 | 0.143 | 0.149 | 0.197 | 0.198 | 13.27 | 48.80 |
| 68-66 | 0.144 | 0.152 | 0.198 | 0.203 | 13.24 | 48.17 |
| 66-64 | 0.153 | 0.160 | 0.213 | 0.217 | 12.61 | 46.36 |
| 64-62 | 0.165 | 0.172 | 0.230 | 0.236 | 11.90 | 43.99 |
| 62-60 | 0.169 | 0.174 | 0.236 | 0.240 | 11.65 | 43.48 |
| 60-58 | 0.186 | 0.179 | 0.261 | 0.248 | 10.67 | 42.51 |
| 58-56 | 0.167 | 0.188 | 0.233 | 0.262 | 11.77 | 40.77 |
| 56-54 | 0.179 | 0.174 | 0.251 | 0.239 | 11.06 | 43.58 |
| 54-52 | 0.167 | 0.169 | 0.233 | 0.232 | 11.76 | 44.45 |

FIGURE 3.1.1. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR BOTH SEXES (1978 TFS)



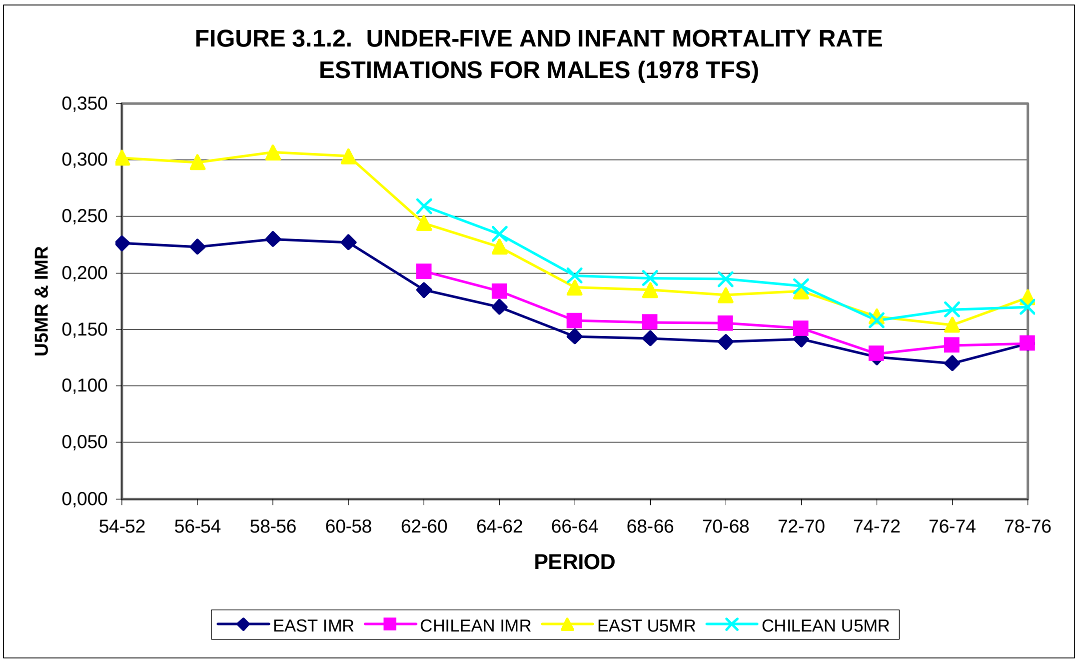


FIGURE 3.1.2. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR MALES (1978 TFS)
U5MR & IMR
0,350
0,300
0,250
0,200
0,150
0,100
0,050
0,000
54-52
56-54
58-56
60-58
62-60
64-62
66-64
68-66
70-68
72-70
74-72
76-74
78-76
PERIOD
EAST IMR
CHILEAN IMR
EAST U5MR
CHILEAN U5MR

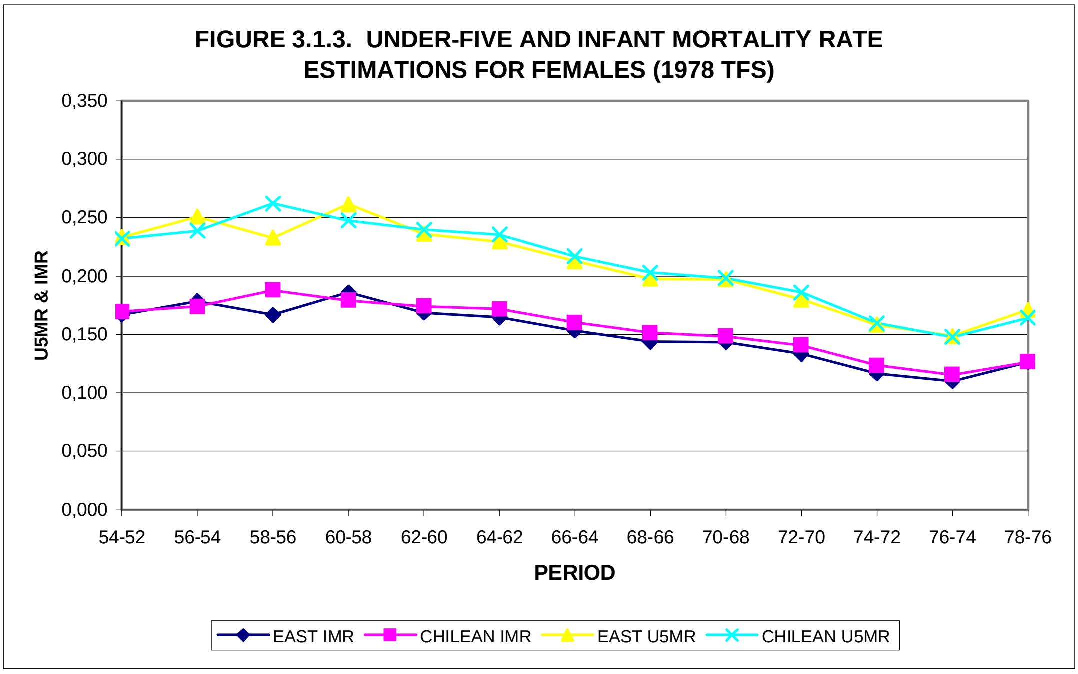


FIGURE 3.1.3. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR FEMALES (1978 TFS)
U5MR & IMR
0,350
0,300
0,250
0,200
0,150
0,100
0,050
0,000
54-52
56-54
58-56
60-58
62-60
64-62
66-64
68-66
70-68
72-70
74-72
76-74
78-76
PERIOD
EAST IMR
CHILEAN IMR
EAST U5MR
CHILEAN U5MR

When the estimations of the regions are considered it is seen that the variation is higher in regional base. West region has the lowest mortality estimates with South region. IMR was estimated as 113 ‰ for the first period (Table 3.1.4.). As it is seen in the Figure 3.1.4. there are two small fluctuations in the periods 74-72 and 68-66 for west region. U5MR was calculated as 148 per thousand for 78-76 period with East model and 141 per thousand with Chilean model. The highest values were calculated for period 58-56.

South region has also low estimates but there is an insignificant increase in period 60-58 and fast drop in past periods (Figure 3.1.5). These fluctuations can not be explained by regular mortality trends. For closer periods, estimates of South region are the lowest. Especially for U5MR, there is no big difference between model estimates. IMR was calculated around 100 per thousand from 68-66 period to the last period. Same trend is consistent with U5MR estimates. U5MR was estimated about 100 ‰ for instance (Table 3.1.5).

The trend of the early age mortality is very significant for Central region. The estimates for IMR and U5MR are dropping from very high values to relatively low values. The estimates of the past three periods can not be computed by the method by using Chilean model. However, estimates of the two models are very close each other for every period. The IMR was calculated as 229 ‰ for the period 54-52 and 144 ‰ for the period 78-76 with East model (Table 3.1.6). It can be seen from the Figure 3.1.6 that the gap is increasing when the estimates of IMR and U5MR are both high. Calculated East level values are very low particularly for early periods.

The estimations for the region North also have some problems for the period 58-56 and 68-66. There are some jumps in the Figure 3.1.7 for these periods. IMR was calculated as 132 per thousand for the last period. The estimates of IMR approaches 190 for the first period and the estimates of the U5MR approaches 250 per thousand (Table 3.1.7). There is a significant drop in the estimates. The lowest estimated expectation of life at birth is about 39 years.

The East region has the most dramatic estimates with the biggest drop. For the first five periods, Chilean model did not allow to estimate the values. The decline in the estimates starts with the period 60-58. For the last period the IMR was estimated as 148 ‰ and U5MR was estimated as 191 ‰ with Chilean model (Table 3.1.8). The estimates with the Chilean model less fluctuated than the estimates with the East model. Figure 3.1.8 shows that there is no difference in the estimates of the two models.

When the results of the level estimates were compared, it can be observed that the levels ranging for both sexes from 11 to 16. Figure 3.1.9 shows the trends of the mortality very clearly with the use of East model. The lowest of the estimates are seen between the years 1952 and 1960, and after 1960 a considerable increase started and continued. The similar assessment can be said by looking the $e_0$ values. Figure 3.1.10. shows this clearly. The expectation of life has increased about 12-13 years in 25 years.

When the east levels of region were reviewed, the regional differences of the mortality trends can be seen clearly. The regions East and Centre have the bottommost level estimates. Where as the regions West and the South have the best mortality levels. According to the estimates, East and Centre have just reached the level of West and South has 25 years ago. The same trend is also observed from the $e_0$ estimations of the regions (Figure 3.1.12)

TABLE 3.1.4. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR WEST (1978 TFS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 78-76 | 0.113 | 0.113 | 0.148 | 0.141 | 16.07 | 55.53 |
| 76-74 | 0.101 | 0.114 | 0.131 | 0.142 | 16.88 | 55.33 |
| 74-72 | 0.094 | 0.097 | 0.121 | 0.119 | 17.35 | 58.75 |
| 72-70 | 0.104 | 0.109 | 0.135 | 0.136 | 16.68 | 56.26 |
| 70-68 | 0.119 | 0.130 | 0.156 | 0.165 | 15.69 | 52.12 |
| 68-66 | 0.106 | 0.118 | 0.138 | 0.148 | 16.54 | 54.42 |
| 66-64 | 0.118 | 0.126 | 0.155 | 0.158 | 15.72 | 53.01 |
| 64-62 | 0.140 | 0.151 | 0.186 | 0.195 | 14.35 | 48.13 |
| 62-60 | 0.142 | 0.155 | 0.190 | 0.201 | 14.19 | 47.42 |
| 60-58 | 0.158 | 0.166 | 0.212 | 0.218 | 13.25 | 45.37 |
| 58-56 | 0.165 | 0.176 | 0.222 | 0.233 | 12.81 | 43.63 |
| 56-54 | 0.159 | 0.169 | 0.214 | 0.222 | 13.17 | 44.92 |
| 54-52 | 0.150 | 0.156 | 0.201 | 0.202 | 13.71 | 47.28 |

TABLE 3.1.5. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR SOUTH (1978 TFS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 78-76 | 0.104 | 0.104 | 0.135 | 0.128 | 16.68 | 57.38 |
| 76-74 | 0.100 | 0.111 | 0.129 | 0.138 | 16.96 | 55.85 |
| 74-72 | 0.102 | 0.106 | 0.133 | 0.131 | 16.79 | 56.86 |
| 72-70 | 0.111 | 0.118 | 0.145 | 0.148 | 16.21 | 54.53 |
| 70-68 | 0.105 | 0.116 | 0.136 | 0.145 | 16.64 | 54.87 |
| 68-66 | 0.098 | 0.107 | 0.126 | 0.133 | 17.10 | 56.67 |
| 66-64 | 0.113 | 0.122 | 0.149 | 0.153 | 16.03 | 53.69 |
| 64-62 | 0.133 | 0.145 | 0.176 | 0.186 | 14.78 | 49.31 |
| 62-60 | 0.159 | 0.172 | 0.214 | 0.226 | 13.15 | 44.47 |
| 60-58 | 0.208 | 0.220 | 0.285 | 0.299 | 10.41 | 36.43 |
| 58-56 | 0.172 | 0.185 | 0.233 | 0.246 | 12.39 | 42.08 |
| 56-54 | 0.163 | 0.160 | 0.219 | 0.208 | 12.93 | 46.58 |
| 54-52 | 0.152 | 0.157 | 0.204 | 0.204 | 13.57 | 47.04 |

TABLE 3.1.6. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR CENTRE (1978 TFS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 78-76 | 0.144 | 0.144 | 0.193 | 0.185 | 14.05 | 49.42 |
| 76-74 | 0.123 | 0.140 | 0.162 | 0.179 | 15.43 | 50.28 |
| 74-72 | 0.136 | 0.137 | 0.181 | 0.174 | 14.59 | 50.87 |
| 72-70 | 0.154 | 0.163 | 0.207 | 0.212 | 13.44 | 46.05 |
| 70-68 | 0.153 | 0.166 | 0.205 | 0.217 | 13.55 | 45.46 |
| 68-66 | 0.167 | 0.175 | 0.225 | 0.231 | 12.73 | 43.88 |
| 66-64 | 0.163 | 0.173 | 0.219 | 0.228 | 12.94 | 44.21 |
| 64-62 | 0.184 | 0.191 | 0.250 | 0.255 | 11.72 | 41.09 |
| 62-60 | 0.195 | 0.202 | 0.265 | 0.272 | 11.13 | 39.25 |
| 60-58 | 0.212 | 0.215 | 0.290 | 0.292 | 10.23 | 37.19 |
| 58-56 | 0.229 | | 0.313 | | 9.41 | |
| 56-54 | 0.226 | | 0.309 | | 9.55 | |
| 54-52 | 0.229 | | 0.313 | | 9.40 | |

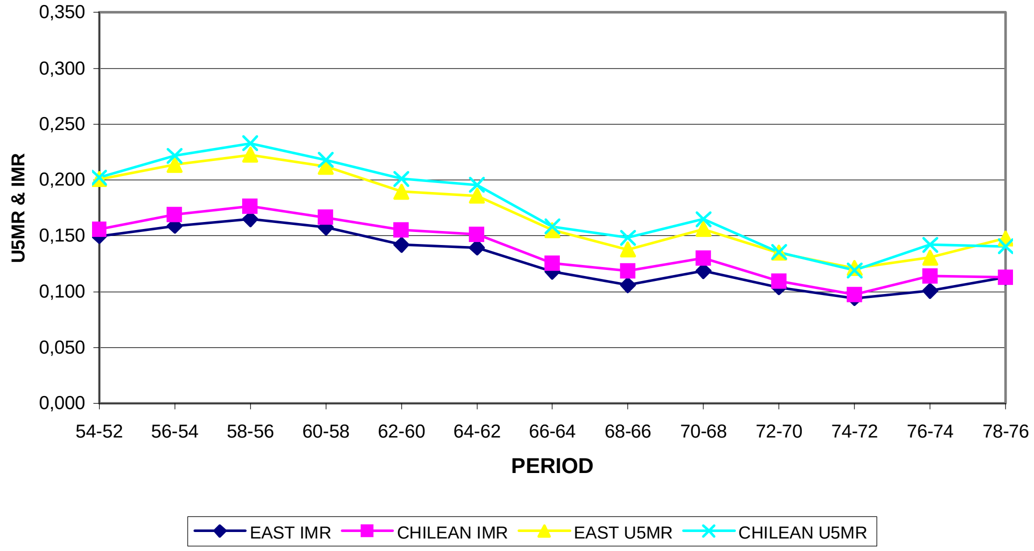
TABLE 3.1.7. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR NORTH (1978 TFS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 78-76 | 0.132 | 0.132 | 0.175 | 0.168 | 14.82 | 51.75 |
| 76-74 | 0.116 | 0.132 | 0.153 | 0.167 | 15.84 | 51.78 |
| 74-72 | 0.126 | 0.129 | 0.167 | 0.163 | 15.18 | 52.41 |
| 72-70 | 0.137 | 0.145 | 0.182 | 0.186 | 14.50 | 49.28 |
| 70-68 | 0.140 | 0.152 | 0.186 | 0.197 | 14.33 | 47.96 |
| 68-66 | 0.167 | 0.177 | 0.225 | 0.233 | 12.72 | 43.60 |
| 66-64 | 0.150 | 0.162 | 0.200 | 0.211 | 13.73 | 46.18 |
| 64-62 | 0.170 | 0.176 | 0.230 | 0.233 | 12.50 | 43.64 |
| 62-60 | 0.160 | 0.170 | 0.215 | 0.223 | 13.12 | 44.80 |
| 60-58 | 0.168 | 0.173 | 0.226 | 0.227 | 12.66 | 44.26 |
| 58-56 | 0.200 | 0.205 | 0.272 | 0.277 | 10.87 | 38.70 |
| 56-54 | 0.169 | 0.175 | 0.227 | 0.231 | 12.61 | 43.82 |
| 54-52 | 0.191 | 0.185 | 0.260 | 0.245 | 11.33 | 42.17 |

TABLE 3.1.8. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR EAST (1978 TFS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 78-76 | 0.148 | 0.148 | 0.199 | 0.191 | 13.80 | 48.65 |
| 76-74 | 0.123 | 0.141 | 0.163 | 0.180 | 15.39 | 50.07 |
| 74-72 | 0.136 | 0.136 | 0.180 | 0.173 | 14.59 | 51.02 |
| 72-70 | 0.162 | 0.170 | 0.218 | 0.223 | 13.00 | 44.77 |
| 70-68 | 0.161 | 0.175 | 0.216 | 0.231 | 13.06 | 43.83 |
| 68-66 | 0.165 | 0.173 | 0.223 | 0.228 | 12.80 | 44.22 |
| 66-64 | 0.178 | 0.184 | 0.241 | 0.245 | 12.06 | 42.26 |
| 64-62 | 0.194 | 0.201 | 0.264 | 0.270 | 11.19 | 39.50 |
| 62-60 | 0.215 | 0.219 | 0.294 | 0.299 | 10.10 | 36.51 |
| 60-58 | 0.261 | | 0.356 | | 7.91 | |
| 58-56 | 0.261 | | 0.355 | | 7.92 | |
| 56-54 | 0.246 | | 0.336 | | 8.59 | |
| 54-52 | 0.243 | | 0.332 | | 8.72 | |

FIGURE 3.1.4. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR WEST (1978 TFS)



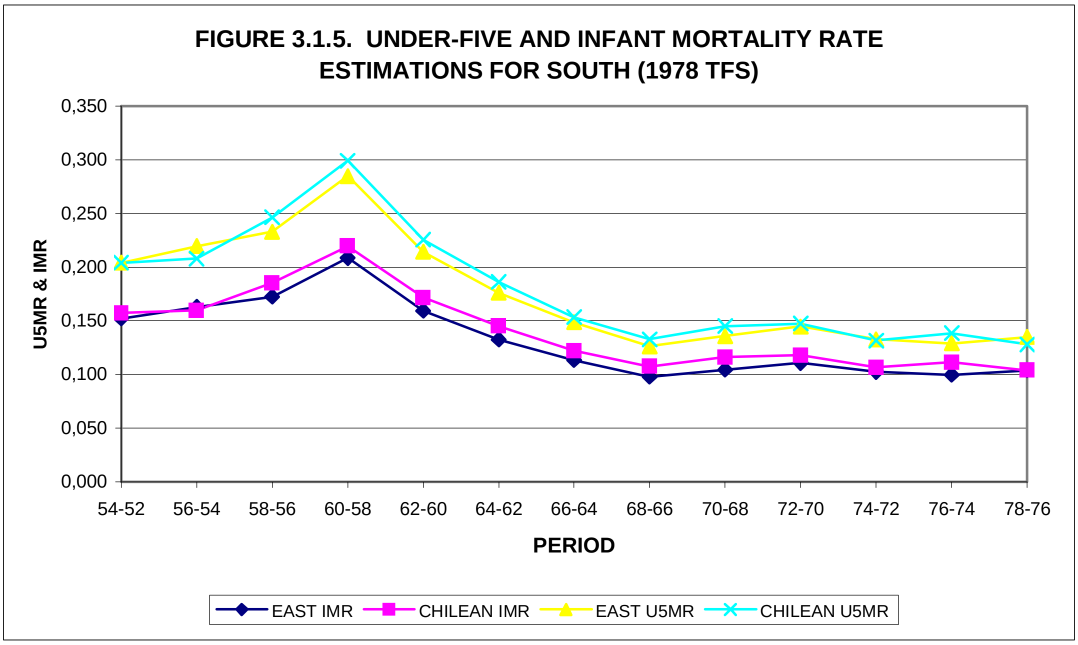


FIGURE 3.1.5. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR SOUTH (1978 TFS)
U5MR & IMR
0,350
0,300
0,250
0,200
0,150
0,100
0,050
0,000
54-52
56-54
58-56
60-58
62-60
64-62
66-64
68-66
70-68
72-70
74-72
76-74
78-76
PERIOD
EAST IMR
CHILEAN IMR
EAST U5MR
CHILEAN U5MR

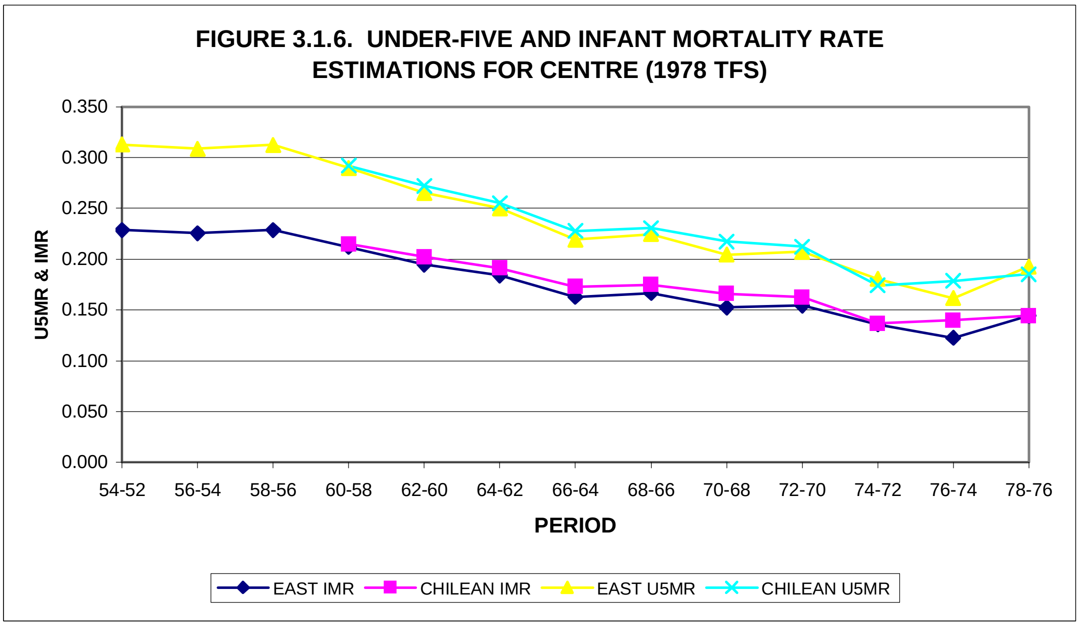


FIGURE 3.1.6. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR CENTRE (1978 TFS)
U5MR & IMR
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
54-52
56-54
58-56
60-58
62-60
64-62
66-64
68-66
70-68
72-70
74-72
76-74
78-76
PERIOD
EAST IMR
CHILEAN IMR
EAST U5MR
CHILEAN U5MR

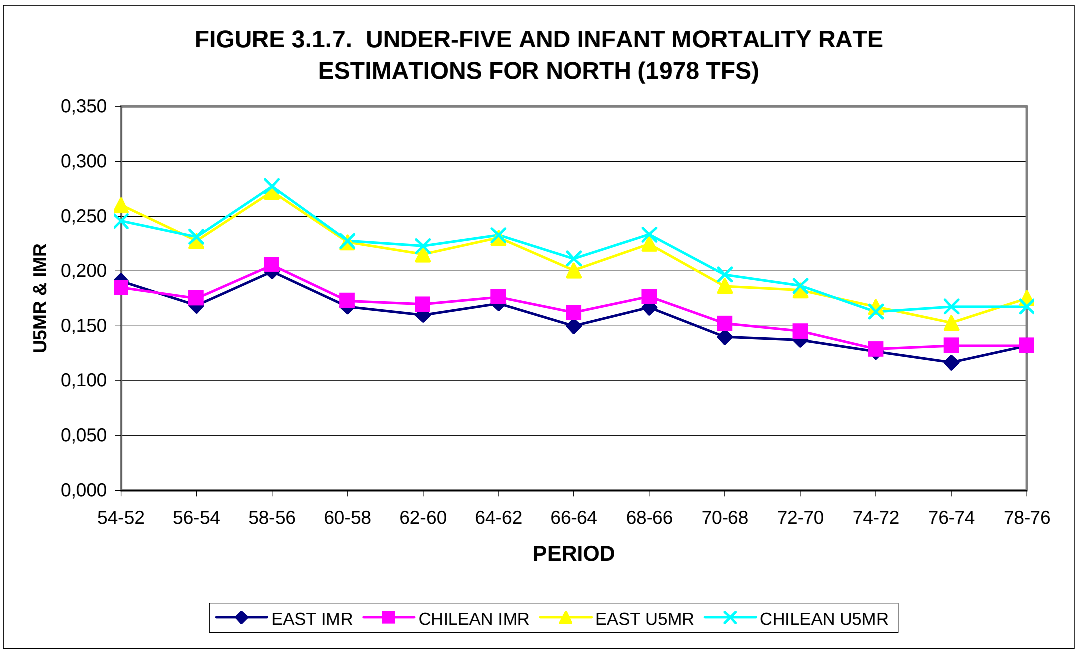


FIGURE 3.1.7. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR NORTH (1978 TFS)
U5MR & IMR
0,350
0,300
0,250
0,200
0,150
0,100
0,050
0,000
54-52
56-54
58-56
60-58
62-60
64-62
66-64
68-66
70-68
72-70
74-72
76-74
78-76
PERIOD
EAST IMR
CHILEAN IMR
EAST U5MR
CHILEAN U5MR

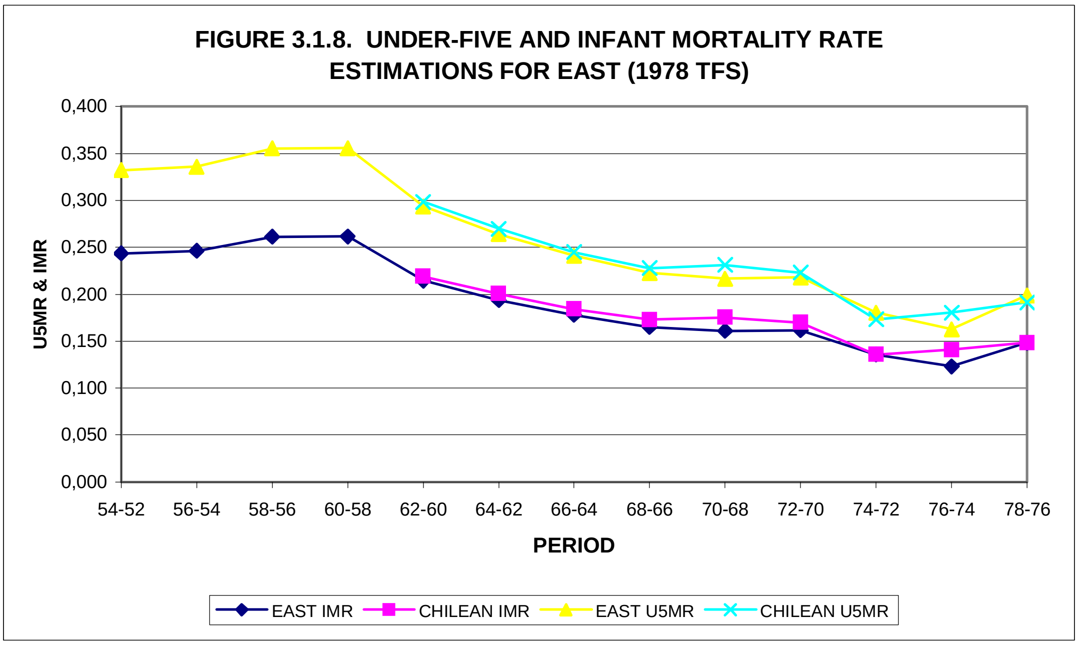


FIGURE 3.1.8. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR EAST (1978 TFS)
U5MR & IMR
0,400
0,350
0,300
0,250
0,200
0,150
0,100
0,050
0,000
54-52
56-54
58-56
60-58
62-60
64-62
66-64
68-66
70-68
72-70
74-72
76-74
78-76
PERIOD
EAST IMR
CHILEAN IMR
EAST U5MR
CHILEAN U5MR

FIGURE 3.1.9. EAST MODEL LEVEL ESTIMATIONS (1978 TFS)

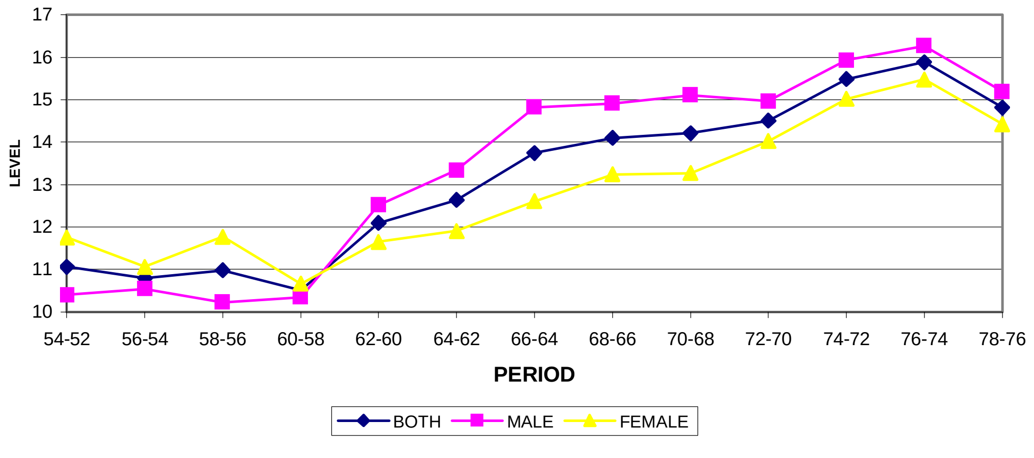



FIGURE 3.1.10. CHILEAN MODEL e(0) ESTIMATIONS (1978 TFS)

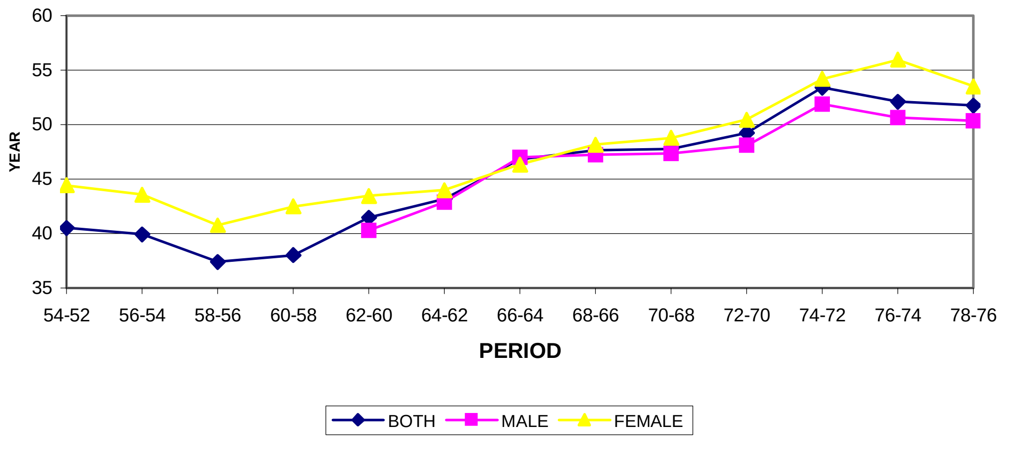


FIGURE 3.1.11. EAST MODEL LEVEL ESTIMATIONS FOR REGIONS (1978 TFS)

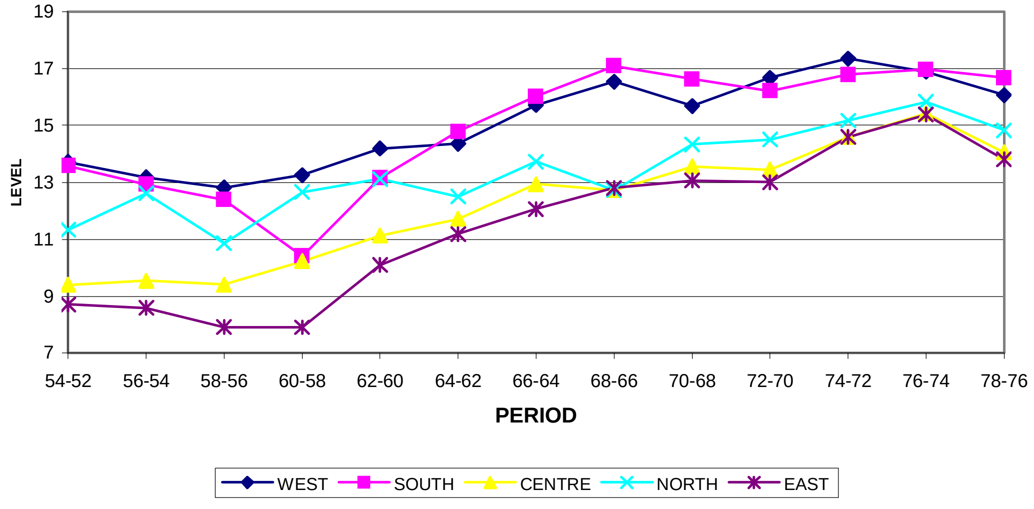
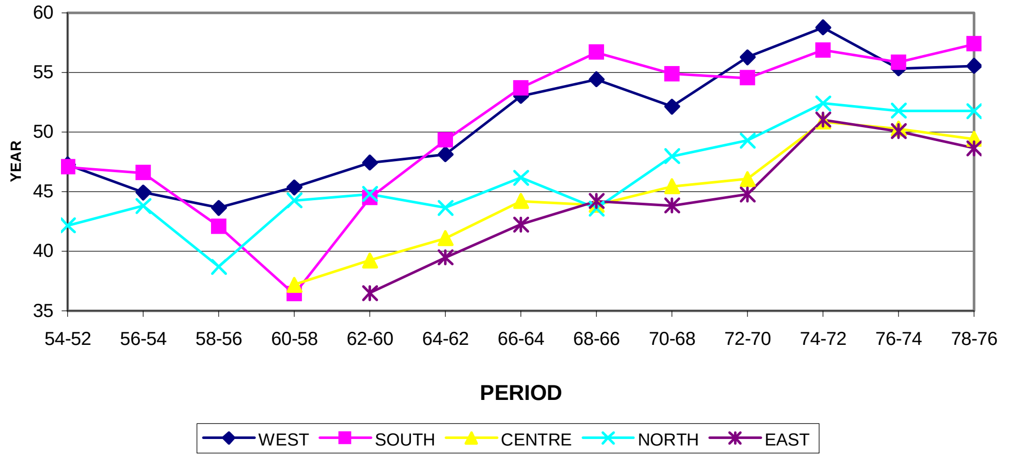



FIGURE 3.1.12. CHILEAN MODEL e(0) ESTIMATIONS FOR REGIONS (1978 TFS)



## 3.2. INDIRECT ESTIMATES OF IMR AND U5MR FROM 1993 TDHS

The indirect estimates of IMR and U5MR and other two indicators from the 1993 TDHS are presented in this section. The results of the estimates from 1993 TDHS are comparably less fluctuated and illustrate more significant shapes of mortality trends. In general, the values of the IMR and U5MRs were closing to each other, of course the their magnitudes were both decreasing the periods surround the survey date. This is what is expected from the natural pattern of mortality. The difference between the IMR and U5MR estimates is approximately 5 ‰ for the last period of the surveys.

The estimates of the two different models were also closing each other. The calculated values of the last ten years are relatively having similar values than the former period estimates. The differences in the estimates become larger in IMR than that are in U5MRs. This is also what is expected from the patterns of the models, since Chilean model has higher infant mortality than the East.

The trend of the infant mortality rate and the under-five mortality rate for the whole country, in other words both sexes, shows a very consistent shape (Figure 3.2.1.). The estimation of IMR for periods 93-91 and 91-89 which was 0.052 just reminds us of the direct IMR estimation of 1993 TDHS. The highest estimate of the IMR was 129 per thousand with East model and 143 per thousand with Chilean model for the first period of the estimates.

The lines in the Figure 3.2.1. can be divided into three parts according to their trend. The first part is from 69-67 to 77-75, then the second part is from 77-75 to 85-83 and the last is from 85-83 to survey date. The U5MR estimates are approximately same for both models up to period 79-77. The biggest variance between estimates of the two models is 12 ‰ for first periods (Table 3.2.1.)

The trends of males are very similar to trends of the both sexes. However, naturally infant mortality and under-five mortality estimates of the males are heavier than the both sexes, particularly for the part, which was mentioned as the first part for both sexes. Expectation of life at birth was about 67 years where as it was 69 years for both sexes and 71 years for females. As it can be seen from the Table 3.2.2., IMR was calculated as 0.082 and U5MR was calculated as 0.101 with East model for period 87-85, which also looks like as the turn point of the trend lines from the Figure 3.2.2.

The estimate of IMR for females is 0.049 and of U5MR is 0.058 for the period 91-89 (Table 3.2.3.). Especially, estimates of U5MRs of both models are very close each other. A small fluctuation between the period 83-81 and 85-83 is seen from the Figure 3.2.3. The estimates of the last period 93-91 are also higher than the estimates of the period 91-89 for females for both models. The level estimates of the east are ranging from 20.35 to 14.45. $e_0$ was estimated as 71.8 years for the period 91-89.

TABLE 3.2.1. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR BOTH SEXES (1993 TDHS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 93-91 | 0.052 | 0.052 | 0.061 | 0.059 | 20.53 | 69.24 |
| 91-89 | 0.052 | 0.055 | 0.062 | 0.063 | 20.50 | 68.64 |
| 89-87 | 0.062 | 0.064 | 0.076 | 0.075 | 19.71 | 66.25 |
| 87-85 | 0.075 | 0.078 | 0.093 | 0.092 | 18.78 | 63.24 |
| 85-83 | 0.080 | 0.086 | 0.101 | 0.103 | 18.36 | 61.46 |
| 83-81 | 0.079 | 0.085 | 0.099 | 0.101 | 18.50 | 61.79 |
| 81-79 | 0.086 | 0.094 | 0.109 | 0.113 | 17.98 | 59.96 |
| 79-77 | 0.095 | 0.105 | 0.122 | 0.129 | 17.32 | 57.54 |
| 77-75 | 0.110 | 0.122 | 0.143 | 0.153 | 16.29 | 54.07 |
| 75-73 | 0.114 | 0.128 | 0.150 | 0.160 | 15.98 | 52.99 |
| 73-71 | 0.123 | 0.136 | 0.163 | 0.172 | 15.38 | 51.30 |
| 71-69 | 0.129 | 0.142 | 0.170 | 0.182 | 15.04 | 50.00 |
| 69-67 | 0.129 | 0.143 | 0.170 | 0.182 | 15.04 | 49.93 |

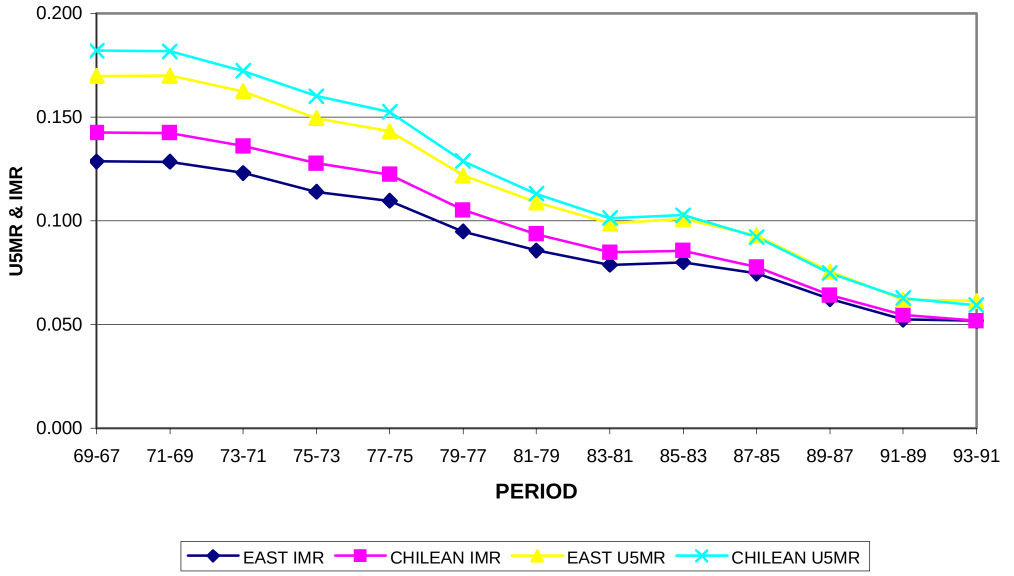
TABLE 3.2.2. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR MALES (1993 TDHS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 93-91 | 0.051 | 0.051 | 0.059 | 0.058 | 21.02 | 67.40 |
| 91-89 | 0.056 | 0.059 | 0.066 | 0.067 | 20.65 | 65.63 |
| 89-87 | 0.063 | 0.065 | 0.075 | 0.075 | 20.14 | 64.33 |
| 87-85 | 0.082 | 0.084 | 0.101 | 0.099 | 18.77 | 60.18 |
| 85-83 | 0.085 | 0.091 | 0.105 | 0.108 | 18.56 | 58.84 |
| 83-81 | 0.091 | 0.096 | 0.113 | 0.115 | 18.17 | 57.82 |
| 81-79 | 0.098 | 0.107 | 0.123 | 0.129 | 17.71 | 55.83 |
| 79-77 | 0.106 | 0.119 | 0.135 | 0.145 | 17.15 | 53.60 |
| 77-75 | 0.120 | 0.137 | 0.154 | 0.169 | 16.25 | 50.51 |
| 75-73 | 0.124 | 0.141 | 0.159 | 0.174 | 16.04 | 49.80 |
| 73-71 | 0.131 | 0.146 | 0.169 | 0.182 | 15.58 | 48.85 |
| 71-69 | 0.134 | 0.150 | 0.173 | 0.187 | 15.43 | 48.26 |
| 69-67 | 0.131 | 0.148 | 0.169 | 0.185 | 15.59 | 48.55 |

TABLE 3.2.3. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR FEMALES (1993 TDHS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 93-91 | 0.053 | 0.053 | 0.064 | 0.061 | 20.00 | 71.16 |
| 91-89 | 0.049 | 0.050 | 0.058 | 0.058 | 20.35 | 71.80 |
| 89-87 | 0.061 | 0.064 | 0.077 | 0.075 | 19.24 | 68.26 |
| 87-85 | 0.067 | 0.071 | 0.085 | 0.085 | 18.79 | 66.44 |
| 85-83 | 0.075 | 0.080 | 0.096 | 0.097 | 18.15 | 64.22 |
| 83-81 | 0.066 | 0.073 | 0.084 | 0.087 | 18.86 | 65.97 |
| 81-79 | 0.073 | 0.080 | 0.094 | 0.097 | 18.27 | 64.29 |
| 79-77 | 0.083 | 0.091 | 0.109 | 0.112 | 17.49 | 61.67 |
| 77-75 | 0.099 | 0.108 | 0.132 | 0.136 | 16.32 | 57.80 |
| 75-73 | 0.104 | 0.114 | 0.139 | 0.145 | 15.93 | 56.34 |
| 73-71 | 0.115 | 0.125 | 0.155 | 0.162 | 15.17 | 53.86 |
| 71-69 | 0.123 | 0.134 | 0.167 | 0.176 | 14.62 | 51.84 |
| 69-67 | 0.126 | 0.137 | 0.171 | 0.179 | 14.45 | 51.38 |

FIGURE 3.2.1. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR BOTH SEXES (1993 TDHS)



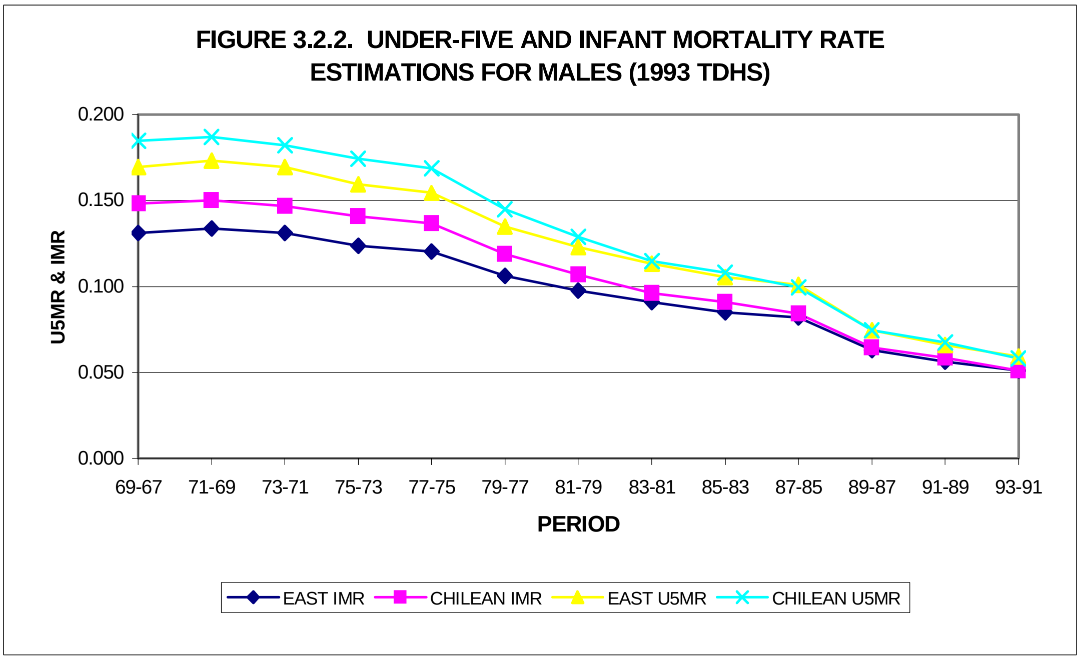


FIGURE 3.2.2. UNDER-FIVE AND INFANT MORTALITY RATE
ESTIMATIONS FOR MALES (1993 TDHS)
U5MR & IMR
0.200
0.150
0.100
0.050
0.000
69-67
71-69
73-71
75-73
77-75
79-77
81-79
83-81
85-83
87-85
89-87
91-89
93-91
PERIOD
EAST IMR
CHILEAN IMR
EAST U5MR
CHILEAN U5MR

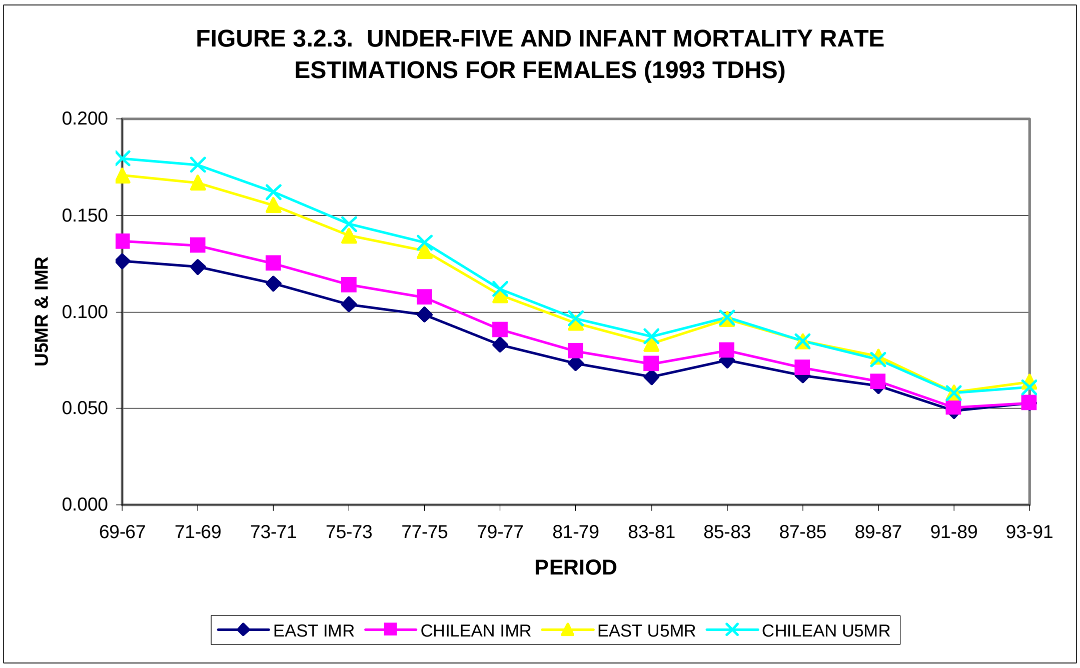


FIGURE 3.2.3. UNDER-FIVE AND INFANT MORTALITY RATE
ESTIMATIONS FOR FEMALES (1993 TDHS)
U5MR & IMR
0.200
0.150
0.100
0.050
0.000
69-67
71-69
73-71
75-73
77-75
79-77
81-79
83-81
85-83
87-85
89-87
91-89
93-91
PERIOD
EAST IMR
CHILEAN IMR
EAST U5MR
CHILEAN U5MR

Not surprisingly, the estimates of regions show variations between the regions. The general patterns of the mortality of the regions keep their structure as they were in the 1978 TFS. West region has the lowest estimates where as the East and Centre has the highest estimates.

The IMR was calculated as 45 ‰ for the last period 93-91 and U5MR was calculated as 53 ‰ and 51 ‰ respectively with models East and Chilean (Table 3.2.4). Expectation of life at birth was as 72 years for the period 91-89. The decline of mortality rates continues regularly for this region.

The region South has a very similar trend with relatively higher values than the region West. But there is a small drop and a small increase in the rates for the period 83-81 (Figure 3.2.5.). The east level estimates are ranging from 20.37 to 16.20 for this region. The estimates of the under-five mortality rates have very similar estimates for both models, except for last 4 periods.

The sharp declines in the early age mortality rates continue for the central region. The estimation of IMR was calculated as 175 per thousand with the Chilean pattern where as, it was calculated as 59 per thousand for the last period (Table 3.2.6.). The IMR decreased three times in 25 years. In addition, the level estimates of the region have raised from 13 to 20. The expectation of life at birth has also increased 22 years according to the estimates.

The estimates of the North region have the most irregular shape, which can not be seen in other regions' trends. There is a big jump for the estimates of the periods between 71-69 and 79-77. However, the last estimates of the both infant mortality rate and the under-five mortality rates have very small estimates. The levels and the expectation of life at birth estimates have changing values, due to fluctuations in the former periods. This fluctuation can be seen from the Figure 3.2.7.

The trend of the East region is very similar to the region centre. The infant mortality rate was computed as 58 ‰ and the under-five mortality rate was computed as 69 ‰ for the last period of the estimation (Table 3.2.8). East region has showed the biggest decline with the Central region. The decline was illustrated in the Figure 3.2.8.

When the East model level estimates are concerned, there is no big variation for the sexes. Level estimates are ranging from 14 or 16 to 20 or 21 for males and females (Figure 3.2.9.). The estimates are higher for males for the last three periods and first four periods, and the same for periods 77-75 and 87-85.

Chilean model $e_0$ estimates are also very consistent during the whole estimation period (Figure 3.2.10). During the preceding 25 years to the survey, expectation of life at birth increased from 50 years to 69 years for both sexes. This increase is 48.5 years to 67.4 years for males and 51.4 years to 71.2 years for females.

East model level estimates and $e_0$ estimates are illustrated in the Figure 3.2.11. and 3.2.12. The figures have the same shapes for regions. Relatively big increase in the levels and $e_0$ values are seen for regions Centre and East. The values of these two regions approach the values of other three regions whose early age mortalities relatively lighter.

TABLE 3.2.4. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR WEST (1993 TDHS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 93-91 | 0.045 | 0.045 | 0.053 | 0.051 | 21.11 | 70.98 |
| 91-89 | 0.038 | 0.041 | 0.044 | 0.046 | 21.70 | 72.21 |
| 89-87 | 0.046 | 0.047 | 0.054 | 0.053 | 21.00 | 70.52 |
| 87-85 | 0.048 | 0.050 | 0.056 | 0.057 | 20.87 | 69.69 |
| 85-83 | 0.059 | 0.061 | 0.070 | 0.071 | 20.00 | 66.86 |
| 83-81 | 0.062 | 0.066 | 0.075 | 0.077 | 19.74 | 65.79 |
| 81-79 | 0.073 | 0.077 | 0.091 | 0.092 | 18.87 | 63.15 |
| 79-77 | 0.079 | 0.085 | 0.099 | 0.102 | 18.47 | 61.45 |
| 77-75 | 0.080 | 0.087 | 0.101 | 0.106 | 18.35 | 60.89 |
| 75-73 | 0.089 | 0.096 | 0.114 | 0.118 | 17.71 | 58.93 |
| 73-71 | 0.099 | 0.109 | 0.128 | 0.136 | 16.99 | 56.24 |
| 71-69 | 0.112 | 0.125 | 0.147 | 0.158 | 16.10 | 53.11 |
| 69-67 | 0.107 | 0.121 | 0.139 | 0.153 | 16.48 | 53.81 |

TABLE 3.2.5. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR SOUTH (1993 TDHS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 93-91 | 0.054 | 0.054 | 0.065 | 0.063 | 20.37 | 68.54 |
| 91-89 | 0.055 | 0.058 | 0.065 | 0.067 | 20.35 | 67.72 |
| 89-87 | 0.061 | 0.063 | 0.074 | 0.073 | 19.81 | 66.50 |
| 87-85 | 0.073 | 0.075 | 0.090 | 0.090 | 18.93 | 63.56 |
| 85-83 | 0.071 | 0.076 | 0.088 | 0.090 | 19.06 | 63.28 |
| 83-81 | 0.062 | 0.067 | 0.075 | 0.078 | 19.75 | 65.56 |
| 81-79 | 0.068 | 0.071 | 0.083 | 0.084 | 19.33 | 64.61 |
| 79-77 | 0.077 | 0.083 | 0.097 | 0.099 | 18.58 | 61.89 |
| 77-75 | 0.087 | 0.094 | 0.111 | 0.115 | 17.87 | 59.37 |
| 75-73 | 0.095 | 0.104 | 0.123 | 0.128 | 17.26 | 57.36 |
| 73-71 | 0.093 | 0.103 | 0.119 | 0.126 | 17.45 | 57.65 |
| 71-69 | 0.111 | 0.121 | 0.145 | 0.152 | 16.20 | 53.87 |
| 69-67 | 0.099 | 0.115 | 0.128 | 0.144 | 17.00 | 55.10 |

TABLE 3.2.6. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR CENTRE (1993 TDHS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 93-91 | 0.059 | 0.059 | 0.070 | 0.069 | 20.01 | 67.40 |
| 91-89 | 0.064 | 0.067 | 0.077 | 0.079 | 19.64 | 65.47 |
| 89-87 | 0.067 | 0.069 | 0.081 | 0.081 | 19.41 | 65.07 |
| 87-85 | 0.080 | 0.083 | 0.101 | 0.100 | 18.37 | 61.81 |
| 85-83 | 0.082 | 0.089 | 0.104 | 0.107 | 18.21 | 60.61 |
| 83-81 | 0.087 | 0.093 | 0.111 | 0.113 | 17.87 | 59.71 |
| 81-79 | 0.096 | 0.103 | 0.123 | 0.126 | 17.24 | 57.62 |
| 79-77 | 0.111 | 0.120 | 0.145 | 0.151 | 16.21 | 54.01 |
| 77-75 | 0.127 | 0.139 | 0.167 | 0.177 | 15.17 | 50.47 |
| 75-73 | 0.126 | 0.139 | 0.166 | 0.178 | 15.24 | 50.41 |
| 73-71 | 0.137 | 0.148 | 0.182 | 0.191 | 14.54 | 48.73 |
| 71-69 | 0.150 | 0.164 | 0.201 | 0.214 | 13.71 | 45.90 |
| 69-67 | 0.162 | 0.175 | 0.218 | 0.231 | 12.99 | 43.79 |

TABLE 3.2.7. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR NORTH (1993 TDHS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 93-91 | 0.041 | 0.041 | 0.047 | 0.046 | 21.51 | 72.22 |
| 91-89 | 0.043 | 0.045 | 0.050 | 0.051 | 21.30 | 71.05 |
| 89-87 | 0.058 | 0.059 | 0.069 | 0.069 | 20.09 | 67.40 |
| 87-85 | 0.085 | 0.088 | 0.108 | 0.106 | 17.98 | 60.75 |
| 85-83 | 0.087 | 0.094 | 0.111 | 0.115 | 17.87 | 59.39 |
| 83-81 | 0.086 | 0.091 | 0.109 | 0.111 | 17.96 | 60.03 |
| 81-79 | 0.088 | 0.095 | 0.112 | 0.116 | 17.79 | 59.22 |
| 79-77 | 0.105 | 0.114 | 0.136 | 0.142 | 16.63 | 55.25 |
| 77-75 | 0.137 | 0.149 | 0.182 | 0.192 | 14.54 | 48.54 |
| 75-73 | 0.133 | 0.147 | 0.176 | 0.189 | 14.79 | 48.91 |
| 73-71 | 0.136 | 0.145 | 0.180 | 0.187 | 14.59 | 49.24 |
| 71-69 | 0.100 | 0.113 | 0.129 | 0.140 | 16.97 | 55.60 |
| 69-67 | 0.102 | 0.111 | 0.132 | 0.138 | 16.83 | 55.90 |

TABLE 3.2.8. INFANT AND UNDER-FIVE MORTALITY RATE, AND LEVEL AND e(0) ESTIMATIONS FOR EAST (1993 TDHS)

| | IMR | | U5MR | | LEVEL | e(0) |
|---|---|---|---|---|---|---|
| PERIOD | EAST | CHILEAN | EAST | CHILEAN | EAST | CHILEAN |
| 93-91 | 0.058 | 0.058 | 0.069 | 0.068 | 20.07 | 67.60 |
| 91-89 | 0.060 | 0.064 | 0.072 | 0.074 | 19.91 | 66.29 |
| 89-87 | 0.076 | 0.077 | 0.095 | 0.092 | 18.69 | 63.07 |
| 87-85 | 0.087 | 0.092 | 0.111 | 0.112 | 17.85 | 59.84 |
| 85-83 | 0.098 | 0.105 | 0.127 | 0.130 | 17.05 | 57.13 |
| 83-81 | 0.096 | 0.104 | 0.124 | 0.128 | 17.20 | 57.37 |
| 81-79 | 0.101 | 0.109 | 0.131 | 0.135 | 16.86 | 56.32 |
| 79-77 | 0.101 | 0.112 | 0.131 | 0.140 | 16.85 | 55.65 |
| 77-75 | 0.118 | 0.130 | 0.156 | 0.165 | 15.70 | 52.16 |
| 75-73 | 0.128 | 0.142 | 0.170 | 0.182 | 15.05 | 49.86 |
| 73-71 | 0.150 | 0.162 | 0.201 | 0.212 | 13.71 | 46.14 |
| 71-69 | 0.161 | 0.174 | 0.216 | 0.229 | 13.07 | 44.03 |
| 69-67 | 0.160 | 0.172 | 0.215 | 0.226 | 13.10 | 44.40 |

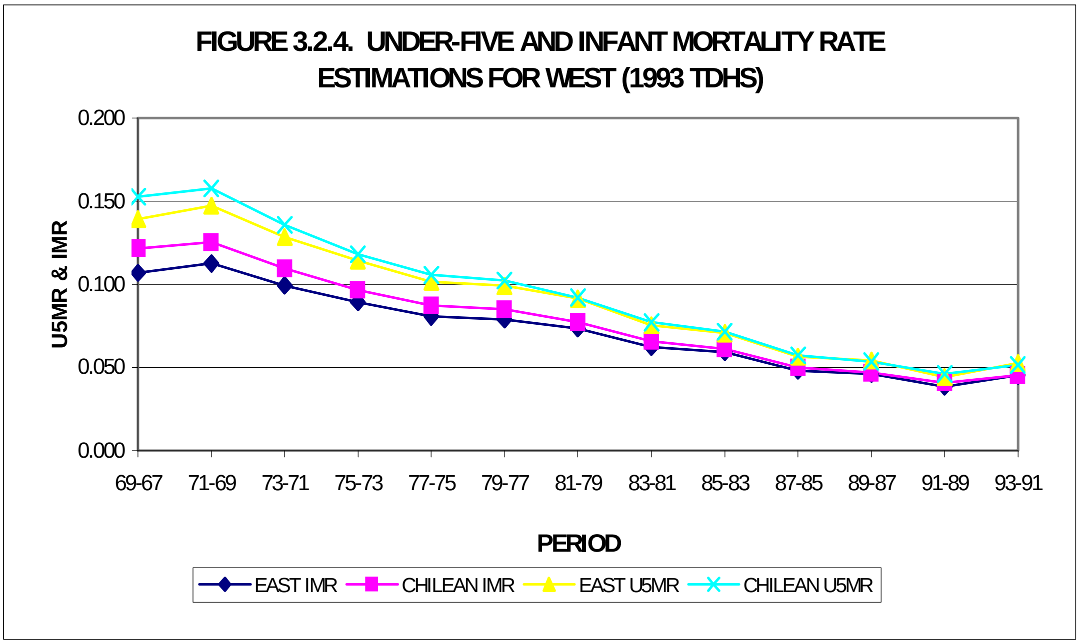


FIGURE 3.2.5. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR SOUTH (1993 TDHS)

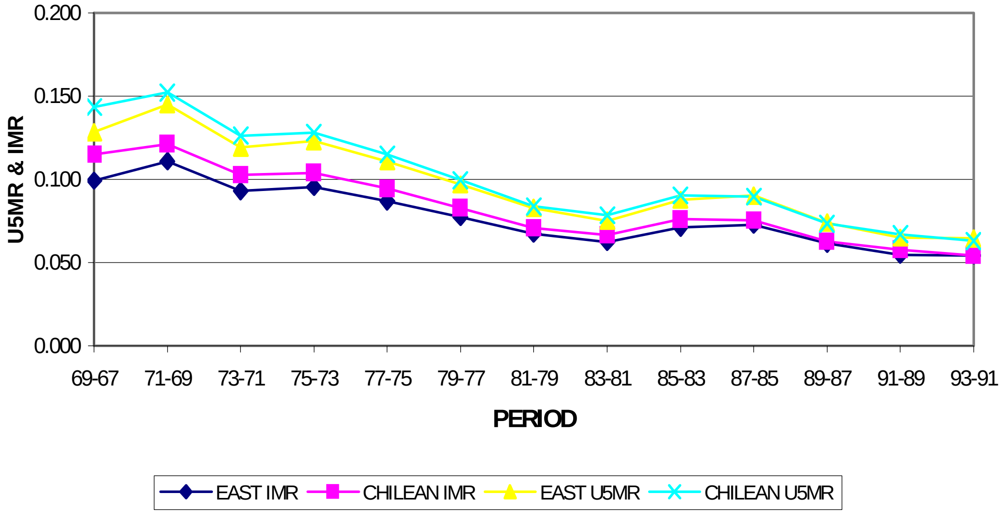



FIGURE 3.2.6. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR CENTRE (1993 TDHS)

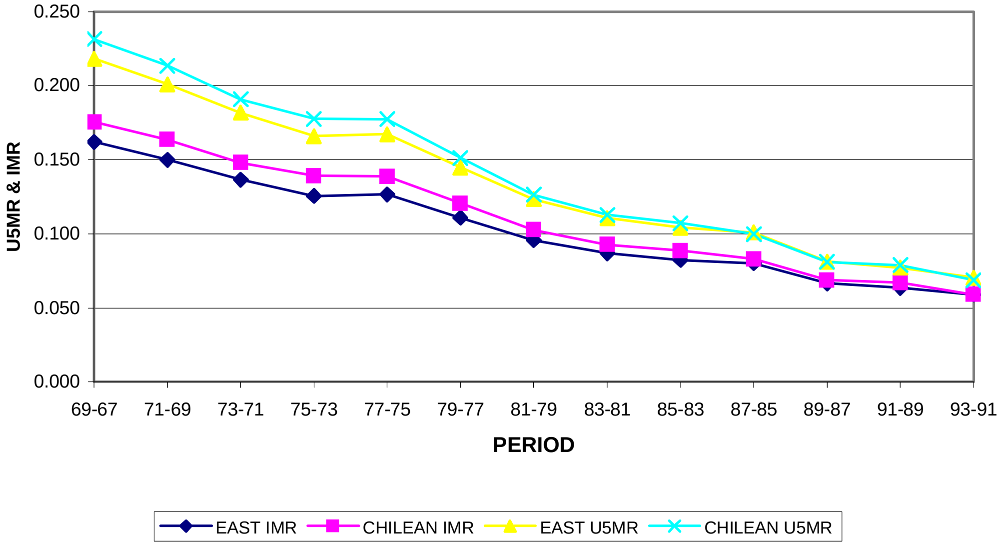


**FIGURE 3.2.7. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR NORTH (1993 TDHS)**

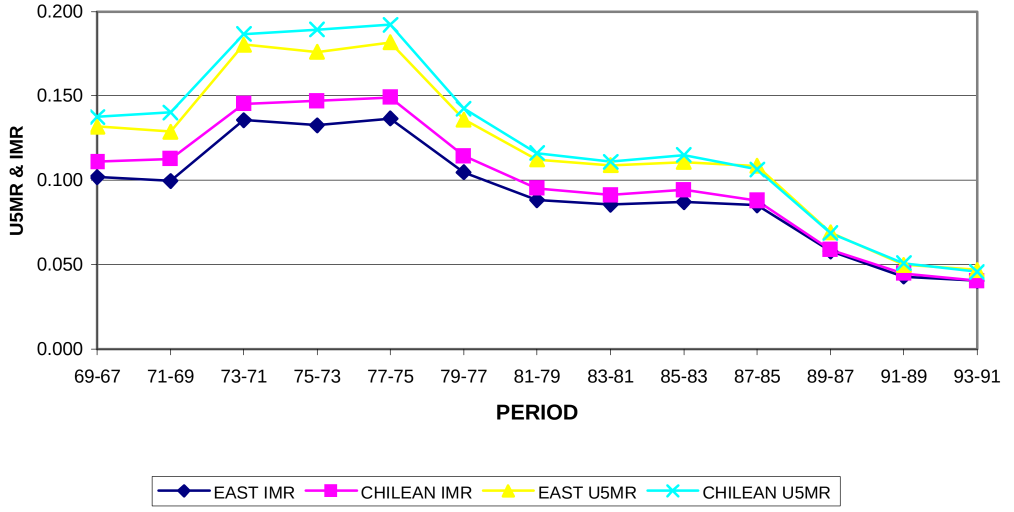



**FIGURE 3.2.8. UNDER-FIVE AND INFANT MORTALITY RATE ESTIMATIONS FOR EAST SEXES (1993 TDHS)**

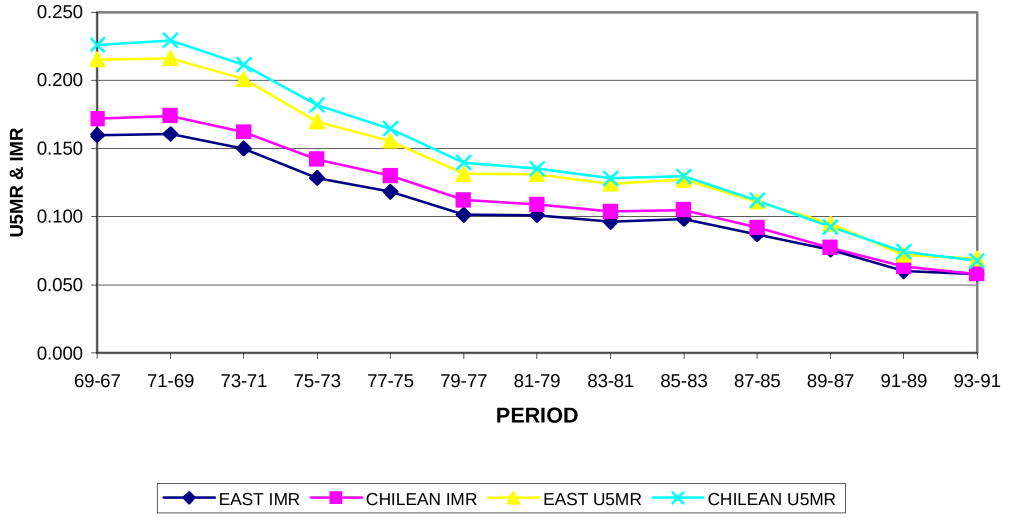


FIGURE 3.2.9. EAST MODEL LEVEL ESTIMATIONS (1993 TDHS)

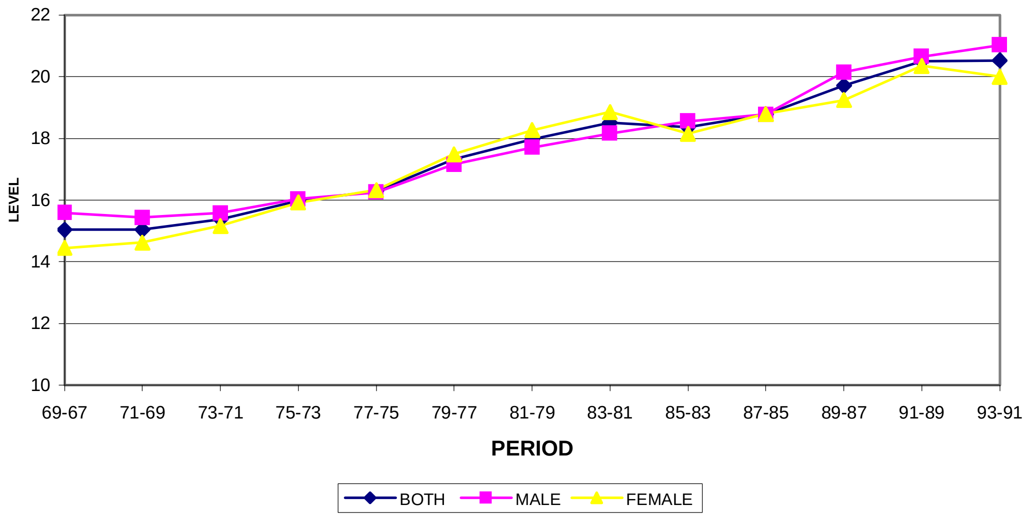



FIGURE 3.2.10. CHILEAN MODEL e(0) ESTIMATIONS (1993 TDHS)

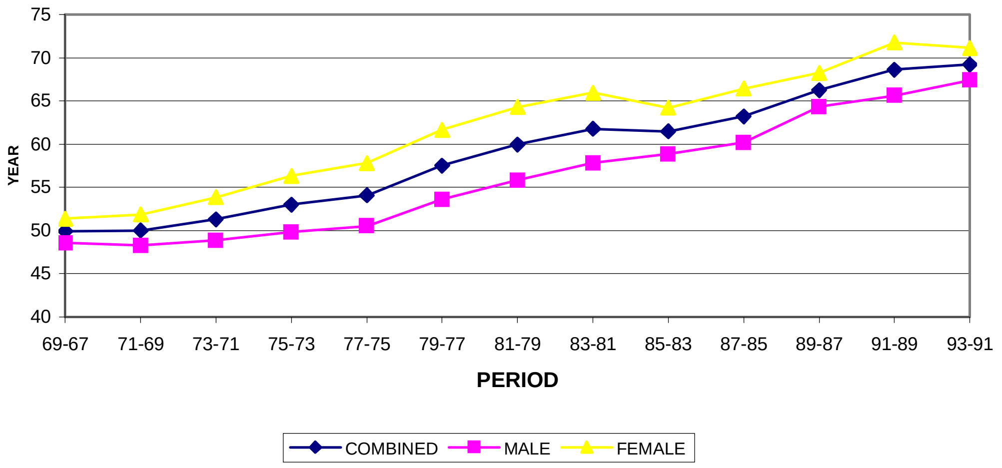


FIGURE 3.2.11. EAST MODEL LEVEL ESTIMATIONS FOR REGIONS (1993 TDHS)

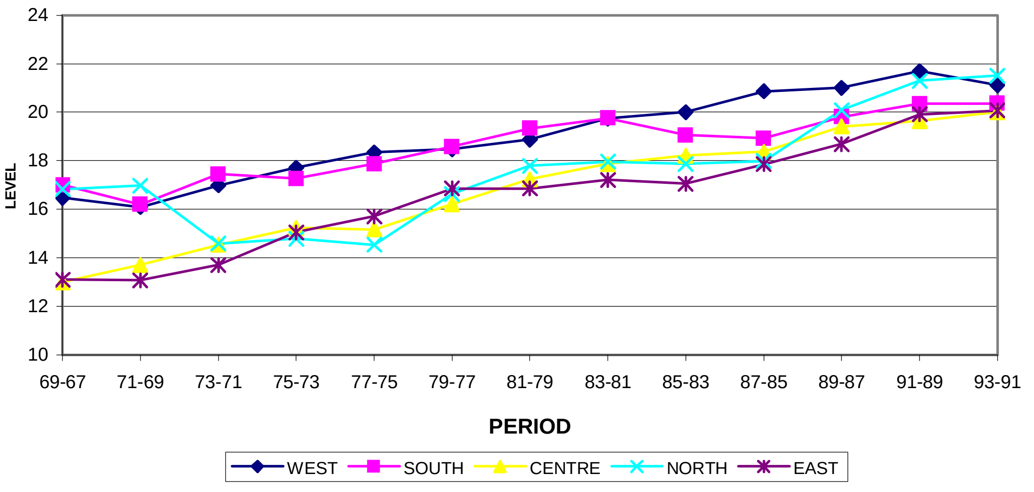
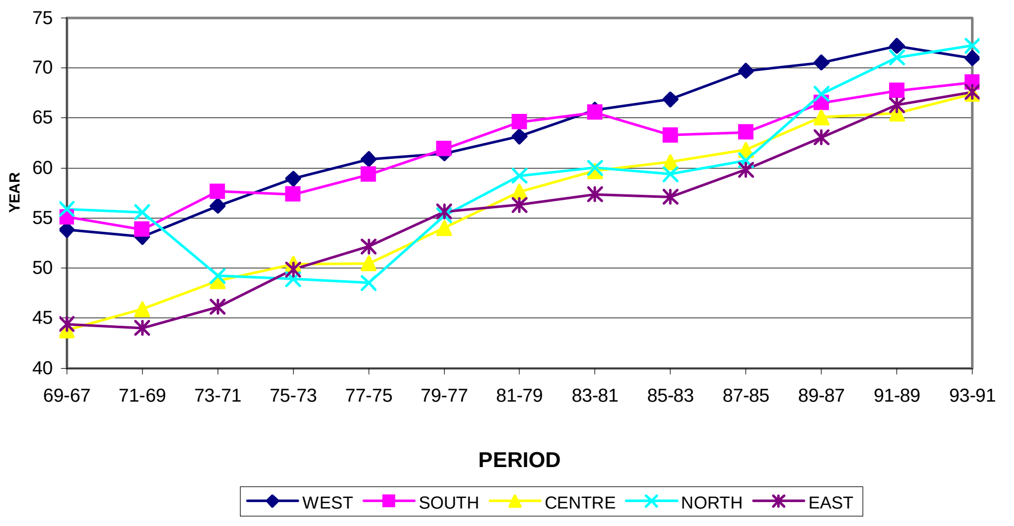



FIGURE 3.2.12. CHILEAN MODEL e(0) ESTIMATIONS FOR REGIONS (1993 TDHS)



## 3.3 COMPARISONS OF THE RESUTS

In this section, the results of the study from both surveys are compared and discussed. Firstly, the results of the 1978 TFS and 1993 TDHS are compared. Then, the results of the surveys are compared with some other independent direct and indirect estimates of infant mortality rate and under-five mortality rate.

### 3.3.1. Comparison of the Results of the Surveys

The estimations from 1978 Turkish Fertility Survey stand for about 26 years long period which is between the years 1952 and 1978. Corresponding period for 1993 Turkish Demographic and Health Survey is between years 1969 and 1993. As mentioned before, the estimates are given for 13 periods prior to the survey date and each of the periods are two years long.

In order to state the comparisons, it is accepted that, the surveys were averagely conducted in September of the survey years. A period refers a time interval that is beginning from the first day of the beginning year of the period and end up with the last day of September of the last year of the period. In other words, the period 1993-1991 is addressed with midyear of the period “1992”. Similarly, 1991-1989 is addressed with “1990”.

This illustration clears the confusions due to period junctions between surveys. For example, the period 1973-1971, which was estimated from 1993 TDHS, was addressed with “1972” and the period 1972-1970, which was estimated from 1978 TFS, was addressed with “1971”. The odd years refer the estimates from 1978 TFS and the even years refer the estimates from 1993 TDHS.

This study gives estimates for approximately 40 years long period. The results of the two surveys are linking for about 10 years period. When the results of the estimates are reviewed, the trend of the early age mortality after fifties can be observed. Absolutely, the estimates are coming from two different sources. However, they are nationwide sample surveys and this allows discussion and comparisons.

The results can be compared according to the sexes and regions and many significant arguments can be declared from these comparisons. Nevertheless, here the examining of the results is mainly done for both sexes. Since the results are given for two alternative models and two surveys, the illustration of the overall trend makes clear the discussion of the results.

When the general trends of the estimates from the two surveys are observed, it is seen that the estimates from the 1978 TFS are higher compared to the estimates from the 1993 TDHS. The indirect estimates of infant mortality have greater values for estimates from 1978 TFS than estimates from 1993 TDHS for the same periods. The IMR was calculated as 129 per thousand from 1978 TFS with East model for 1970 where as it was calculated as 137 per thousand from 1993 TDHS with same model for 1971 (Table 3.3.3.1.). This discrepancy always stands for all linking years.

The same difference can be seen for the estimates of the U5MRs. It was estimated as 170 ‰ from the 1993 TDHS 1968 and as 188 ‰ from the 1978 TFS for 1969. Here the difference is bigger for latter periods. The trend is illustrated in Figure 3.3.2. There is an insignificant jump in the estimates for year 1977. This figure probably overestimates especially estimation with East model, when the trend is considered.

If the results are combined without any smoothing or mathematical calculation, a decreasing trend in both rates can be observed. Figure 3.3.3. shows this 40 years trend for both estimates with both models. Except for three jumps in the years 1968, 1970 and 1977, a very meaningful trend stands for both infant mortality rate and under-five mortality rate. For the first five years of the period, there is a stable pattern for the early age mortality. This may be due to some errors for the former periods that were discussed in the methodology section.

TABLE 3.3.3.1 INDIRECT ESTIMATIONS OF IMR FOR BOTH SEXES

| YEAR | EAST IMR 1993 | CHILEAN IMR 1993 | EAST IMR 1978 | CHILEAN IMR 1978 |
|---|---|---|---|---|
| 1992 | 0.052 | 0.052 | | |
| 1990 | 0.052 | 0.055 | | |
| 1988 | 0.062 | 0.064 | | |
| 1986 | 0.075 | 0.078 | | |
| 1984 | 0.080 | 0.086 | | |
| 1982 | 0.079 | 0.085 | | |
| 1980 | 0.086 | 0.094 | | |
| 1978 | 0.095 | 0.105 | | |
| 1977 | | | 0.132 | 0.132 |
| 1976 | 0.110 | 0.122 | | |
| 1975 | | | 0.115 | 0.130 |
| 1974 | 0.114 | 0.128 | | |
| 1973 | | | 0.121 | 0.123 |
| 1972 | 0.123 | 0.136 | | |
| 1971 | | | 0.137 | 0.145 |
| 1970 | 0.129 | 0.142 | | |
| 1969 | | | 0.141 | 0.153 |
| 1968 | 0.129 | 0.143 | | |
| 1967 | | | 0.143 | 0.154 |
| 1965 | | | 0.148 | 0.158 |
| 1963 | | | 0.167 | 0.179 |
| 1961 | | | 0.177 | 0.189 |
| 1959 | | | 0.207 | 0.210 |
| 1957 | | | 0.199 | 0.214 |
| 1955 | | | 0.201 | 0.198 |
| 1953 | | | 0.197 | 0.195 |

TABLE 3.3.3.2. INDIRECT ESTIMATIONS OF U5MR FOR BOTH SEXES

| YEAR | EAST U5MR 1993 | CHILEAN U5MR 1993 | EAST U5MR 1978 | CHILEAN U5MR 1978 |
|---|---|---|---|---|
| 1992 | 0.061 | 0.059 | | |
| 1990 | 0.062 | 0.063 | | |
| 1988 | 0.076 | 0.075 | | |
| 1986 | 0.093 | 0.092 | | |
| 1984 | 0.101 | 0.103 | | |
| 1982 | 0.099 | 0.101 | | |
| 1980 | 0.109 | 0.113 | | |
| 1978 | 0.122 | 0.129 | | |
| 1977 | | | 0.175 | 0.168 |
| 1976 | 0.143 | 0.153 | | |
| 1975 | | | 0.151 | 0.165 |
| 1974 | 0.150 | 0.160 | | |
| 1973 | | | 0.160 | 0.155 |
| 1972 | 0.163 | 0.172 | | |
| 1971 | | | 0.182 | 0.186 |
| 1970 | 0.170 | 0.182 | | |
| 1969 | | | 0.188 | 0.198 |
| 1968 | 0.170 | 0.182 | | |
| 1967 | | | 0.191 | 0.199 |
| 1965 | | | 0.200 | 0.206 |
| 1963 | | | 0.226 | 0.236 |
| 1961 | | | 0.240 | 0.252 |
| 1959 | | | 0.283 | 0.284 |
| 1957 | | | 0.271 | 0.290 |
| 1955 | | | 0.275 | 0.266 |
| 1953 | | | 0.268 | 0.261 |

### 3.3.2. Comparisons of the Estimates with Independent Estimates

The results of the estimates are compared with independent estimates in this section. As it was noticed in Chapter I, the infant mortality rate estimates and the under-five mortality rate estimates are calculated from sample surveys or censuses.

These estimates are direct estimates or indirect estimates. There are a few numbers of direct estimates relative to the indirect estimates. And, the number of estimates for under-five mortality rate is less than the number of estimates for infant mortality.

Direct estimates were mainly from the national surveys of Hacettepe Institute of Population Studies. Indirect Estimates were also calculated from these national surveys and population censuses. These estimates are generally Brass type estimates or estimates from birth-survival histories.

Although there some other sources, some estimates were compared from main sources, below sources were considered for infant mortality rate comparison: direct estimates from Surveys, Miroslav Macura's study (revised results in Macura 1982) which is the base of this study, Hancıoğlu's (1991) estimates, and the publication of State Institute of Statistics (SIS). The estimates of the SIS's publication are a combination of Macura and Shorter's estimates and census based estimates for 5 year periods. In order to compare the under-five mortality rate estimates, two direct estimates and Shorter's (1989) and Hancıoğlu's estimates are considered.

Since the estimates were given for single years the tables and the figures are complex. The complexity caused by also four different estimates of the study. However, especially when the figures are considered the general trend of the both infant mortality rate and the under-five mortality rate trends have a shape. The outliers or the density due to similar estimates show the trend and overestimates or underestimates (Figure 3.3.4. and 3.3.5).

A general comment for the estimates of this study can be said for firstly infant mortality rates. The estimates for the past years are closer than the near years to the independent estimates. The estimates for the last eighth years are the same with other independent estimates. The direct estimates and the estimates of the study are equivalent for 1991 and 1985. They are also parallel with the estimates of Hancıoğlu and SIS.

Except for first two estimates, the estimates from 1978 TFS with Chilean are very identical with Macura's estimates for years between 1957 and 1963. Chilean model estimates are closer to the independent estimates for antecedent years. The estimates of the 1953, 1955 and 1957 seem as outliers. Estimates with East model from 1993 TDHS gives the lowest estimates. The biggest variations in the estimates occur in the middle periods.

The direct estimates of the under-five mortality rate are similar the estimates of the study. In addition, the estimates of the Shorter are exactly alike with estimate from 1978 TFS with Chilean model. He has estimated the underfive mortality rate as 0.200 for 1967 and 0.167 1977 and the estimates from 1978 TFS are 0.199 and 0.167, respectively. There are differences with Hancıoğlu's estimates.

When the estimations for males and females are compared, the estimation of this study have lighter infant mortality rates as it is for both sexes, but there is a consistency of higher infant mortality rates for males than females. The trends are parallel to the trends of independent infant mortality rate estimates. There is similar trend for under-five mortality with limited estimations.

When the regional comparisons are considered, very similar trends are observed for the regions. As in the estimates of this study, region west has the lightest mortality rates, both in infant mortality and under-five mortality. The region south has relatively low rates.

The central region and the east region have the highest mortality rate estimates both in independent estimates and the estimates of the thesis. However, the estimates of the thesis have lower values when they are compared with. The north region has again most fluctuated estimates with south region where it has also some jumps for the past periods. The north does not allow some direct estimates due to less number of observations for independent estimates.

TABLE 3.3.3 COMPARISON OF INFANT MORTALITY RATE ESTIMATES FOR BOTH SEXES

| PERIOD | YEAR | DIRECT | SIS 1995 | MACURA | HANCIOGLU | EAST-78 | CHIL-78 | EAST-93 | CHIL-93 |
|---|---|---|---|---|---|---|---|---|---|
| 1935-40 | 1937 | | 0.273 | | | | | | |
| | 1938 | | | | | | | | |
| | 1939 | | | | | | | | |
| | 1940 | | | | | | | | |
| | 1941 | | | | | | | | |
| 1940-45 | 1942 | | 0.306 | | | | | | |
| | 1943 | | | | | | | | |
| | 1944 | | | | | | | | |
| | 1945 | | | 0.274 | | | | | |
| | 1946 | | | | | | | | |
| 1945-50 | 1947 | | 0.260 | 0.270 | | | | | |
| | 1948 | | | | | | | | |
| | 1949 | | | 0.255 | | | | | |
| | 1950 | | | | | | | | |
| | 1951 | | | 0.245 | | | | | |
| 1950-55 | 1952 | | 0.233 | | | | | | |
| | 1953 | | | 0.235 | | 0.197 | 0.195 | | |
| | 1954 | | | | | | | | |
| | 1955 | | | 0.224 | | 0.201 | 0.198 | | |
| | 1956 | | | | | | | | |
| 1955-60 | 1957 | | 0.203 | 0.212 | | 0.199 | 0.214 | | |
| | 1958 | | | | | | | | |
| | 1959 | | | 0.199 | | 0.207 | 0.210 | | |
| | 1960 | | | | | | | | |
| | 1961 | | | 0.189 | | 0.177 | 0.189 | | |
| 1960-65 | 1962 | | 0.176 | | | | | | |
| | 1963 | | | 0.178 | | 0.167 | 0.179 | | |
| | 1964 | | | | | | | | |
| | 1965 | | | 0.169 | | 0.148 | 0.154 | | |
| | 1966 | 0.165 | | | 0.169 | | | | |
| 1965-70 | 1967 | | 0.151 | 0.156 | 0.168 | 0.143 | 0.154 | | |
| | 1968 | | | | 0.164 | | | 0.129 | 0.143 |
| | 1969 | | | | 0.161 | 0.141 | 0.153 | | |
| | 1970 | | | | 0.157 | | | 0.129 | 0.142 |
| | 1971 | | | | 0.154 | 0.137 | 0.145 | | |
| 1970-75 | 1972 | | 0.139 | | 0.151 | | | 0.123 | 0.136 |
| | 1973 | | | | 0.147 | 0.121 | 0.123 | | |
| | 1974 | | | | 0.140 | | | 0.114 | 0.128 |
| | 1975 | | | | 0.139 | 0.115 | 0.130 | | |
| | 1976 | 0.134 | | | 0.133 | | | 0.110 | 0.122 |
| 1975-80 | 1977 | | 0.126 | | 0.129 | 0.132 | 0.132 | | |
| | 1978 | | | | 0.128 | | | 0.095 | 0.105 |
| | 1979 | | | | 0.123 | | | | |
| | 1980 | | | | 0.121 | | | 0.086 | 0.094 |
| | 1981 | 0.095 | | | 0.119 | | | | |
| 1980-85 | 1982 | | 0.109 | | 0.115 | | | 0.079 | 0.085 |
| | 1983 | | | | 0.111 | | | | |
| | 1984 | | | | 0.101 | | | 0.080 | 0.086 |
| | 1985 | 0.078 | | | 0.091 | | | | |
| | 1986 | | | | 0.081 | | | 0.075 | 0.078 |
| 1985-90 | 1987 | | 0.067 | | | | | | |
| | 1988 | | | | | | | 0.062 | 0.064 |
| | 1989 | | | | | | | | |
| | 1990 | | | | | | | 0.052 | 0.055 |
| | 1991 | 0.053 | | | | | | | |
| 1990-95 | 1992 | | | | | | | 0.052 | 0.052 |

TABLE 3.3.4 COMPARISON OF UNDER-FIVE MORTALITY RATE ESTIMATES FOR BOTH SEXES

| YEAR | DIRECT | SHORTER | HANCIOGLU | EAST-78 | CHILEAN-78 | EAST-93 | CHILEAN-93 |
|---|---|---|---|---|---|---|---|
| 1953 | | | | 0.268 | 0.261 | | |
| 1954 | | | | | | | |
| 1955 | | | | 0.275 | 0.266 | | |
| 1956 | | | | | | | |
| 1957 | | | | 0.271 | 0.290 | | |
| 1958 | | | | | | | |
| 1959 | | | | 0.283 | 0.284 | | |
| 1960 | | | | | | | |
| 1961 | | | | 0.240 | 0.252 | | |
| 1962 | | | | | | | |
| 1963 | | | | 0.226 | 0.236 | | |
| 1964 | | | | | | | |
| 1965 | | | | 0.200 | 0.206 | | |
| 1966 | 0.218 | | 0.223 | | | | |
| 1967 | | 0.200 | 0.221 | 0.191 | 0.199 | | |
| 1968 | | | 0.215 | | | 0.170 | 0.182 |
| 1969 | | | 0.211 | 0.188 | 0.198 | | |
| 1970 | | | 0.204 | | | 0.170 | 0.182 |
| 1971 | | | 0.201 | 0.182 | 0.186 | | |
| 1972 | | | 0.195 | | | 0.163 | 0.172 |
| 1973 | | | 0.190 | 0.160 | 0.155 | | |
| 1974 | | | 0.180 | | | 0.150 | 0.160 |
| 1975 | | | 0.177 | 0.151 | 0.165 | | |
| 1976 | | | 0.169 | | | 0.143 | 0.153 |
| 1977 | | 0.167 | 0.164 | 0.175 | 0.168 | | |
| 1978 | | | 0.162 | | | 0.122 | 0.129 |
| 1979 | | | 0.155 | | | | |
| 1980 | | | 0.152 | | | 0.109 | 0.113 |
| 1981 | | | 0.149 | | | | |
| 1982 | | 0.142 | 0.143 | | | 0.099 | 0.101 |
| 1983 | | | 0.138 | | | | |
| 1984 | | | 0.124 | | | 0.101 | 0.103 |
| 1985 | | | 0.111 | | | | |
| 1986 | | | 0.097 | | | 0.093 | 0.092 |
| 1987 | | | | | | | |
| 1988 | | | | | | 0.076 | 0.075 |
| 1989 | | | | | | | |
| 1990 | | | | | | 0.062 | 0.063 |
| 1991 | | | | | | | |
| 1992 | 0.061 | | | | | 0.061 | 0.059 |
| 1993 | | | | | | | |
| 1994 | | | | | | | |
| 1995 | | | | | | | |

# CONCLUSION

This study provides some indirect estimates of mortality levels and Turkey's recent past and after 1950s from birth-survival histories. The estimations are short-term estimations and give possibility of making comparisons with other estimates.

In the first chapter, the general information on demographic model life tables and early age mortality pattern was discussed. Firstly, a general overview of the life tables and model life table systems were told. Then, the information on early age mortality in Turkey was considered with the age and sex pattern of Turkey. In this chapter, the most important decision of the thesis was given to select the suitable model life table for calculations. Coale-Demeny East model and United Nations Chilean models were selected. The reason for two modelling is to give alternative estimates for the same periods. The alternative models were chosen by reviewing the previous studies, especially Hancıoğlu (1991) which is an excellent source for Turkish mortality. Direct and indirect estimates of infant and under-five mortality rates were also given in Chapter I. These estimates were compared with the results of the study in the last Chapter.

Chapter II is the methodology chapter of the thesis; in which the data sources of the thesis were presented. These sources are the two nation-wide fertility and health surveys conducted in 1978 and 1993. Next, the original estimation technique of the Miroslav Macura was explained. First of all, the estimation procedure of the technique was illustrated with the original smoothing process. Then the assumptions and the general considerations of the original method were discussed.

The assumptions of the method are very important while making discussions and comparisons. The estimates are directly related to two subjects. The first is the accuracy of the data. The errors in the data affect the estimations very much. The omission of the children, the misreporting of the birth date and the death date, and the sampling variance are the main sources of the data. In order to keep such errors at minimum level, a smoothing process and the use of aggregated cohorts were improved in the original method. As mentioned before the original smoothing method was illustrated in the second chapter. However, a different smoothing process were applied in this study

The second subject that affect the estimates are assumptions. The most important assumption is the model selection. If the pattern of the model does not fit with the real pattern, then the estimates are not reliable. Another assumption of the study is that there is no relation between mortality of women and child. The effects of the childhood mortality experience from rural to urban and effects of migration of women are assumed minimum.

During this study the main body of the method and the formulation system were stated. Some changes that were done in the calculations were described in the second chapter. The first modification in the technique was the calculations of the proportions of deceased children prior to the survey date instead of the survey year. The using of two-year cohorts and the formulation system was kept as they are. However, different alternatives as single year proportions or five-year proportions were experimented.

The smoothing process of the original method was not used. A process named as moving averages was used to smooth the proportions. Since the data structure allows defining the children's birthplace, the proportions for 1993 TDHS were computed without any assumption on the migration of the mother. Combining the results of the male and female estimations to both sexes were done by assuming the sex ratio at birth value as 1.05. Before this assumption, the sex ratios of the periods were discussed. The raw and smoothed proportions of the each variable of both surveys were given. In addition, the life table $l_x$ values for odd ages up to 25 years were computed for calculations and presented in appendix. An example was illustrated to clarify the estimation procedure of the method.

In the third chapter, the results of the application of the method to 1978 TFS and 1993 TDHS were given. The results are presented for each survey with two alternative model estimates. Each survey section gives the estimates of infant and under-five mortality for both sexes, males, females and five geographical regions. Beside the estimates of infant and under-five mortality rates the estimated level of East model life table of each period and estimate of life expectancy of life at birth value from Chilean model were computed.

When the results from 1978 TFS were considered, the estimates of IMR and U5MR are very close although the estimates of Chilean model are higher. The variation in the Chilean model in the period close to the survey date is less than that of East. Males have higher mortality rates compared to females. The difference in males' estimates is bigger than that of both sexes and estimations for females are less fluctuated.

Variation in the estimates is higher in the regional base for 1978 TFS. West and south region has the lowest estimates while there are some data problems for the north region the trend of the early age mortality is very significant for central region. A very meaningful drop was observed in the trend of the east region. East and centre has the highest rates for both infant and under-five mortality. Some period estimation could not be computed with Chilean model for Males, Centre and East. Level estimates are ranging from 11 to 16, $e_0$ estimates are ranging from 43 to 58 for both sexes.

It can be concluded that the infant mortality rate has dropped from 129 per thousand (East) or 143 per thousand to 52 per thousand. This means it decreased more than two times in forty years. Similarly, the under-five mortality rate has dropped from 197 ‰ to 132 ‰.

The estimates that were computed from 1993 TDHS data are relatively less fluctuated and shows more significant trends. The estimated values of IMR and U5MR were close to each other. The estimates of the two models were also very close to each other. The trend of the early age mortality is very agreeable shape. The trends of males and females are similar to each other. Of course the estimates of males are higher.

The variations of the estimates are the same for 1978 TFS and 1993 TDHS. The West and the south regions again have the lower estimates and the decline continues in the regions Centre and East. North again has an irregular shape.

The East model level estimates for the 1993 TDHS results show no big variation. $e_0$ estimates are also consistent. One identical observation of the trends is the approaching $e_0$ values of the East and Centre region to the others.

An approximately forty years long period of the Turkish early age mortality had some new estimates for two-year log periods with the results of this study. The results show a trend also for a 10 year period the surveys are linking.

First of all, as it is expected, the estimates from Chilean model were resulted with higher rates for both infant mortality rate and under-five mortality rate. The differences between estimates from Chilean model and East model are higher for estimates for former periods. This means, when the absolute magnitude of the rate is small the difference between estimates from the models become small.

The general trend of the TFS is for higher rates than the 1993 TDHS. There is a discrepancy for all linking years for two surveys. The combining shape of the results of the two surveys gives a trend shape for early age mortality. The decline in the both mortality rates is consistent with a few outliers.

Comparison of the results of the study with other independent direct or indirect estimates gave a satisfactory consistency. The estimates for the former years had closer results than the near years. As mentioned in the last chapter, the infant mortality rate estimates of the last eight years are the same with other independent estimates. The results are also consistent with the direct estimates.

Chilean model infant mortality rate estimates are closer to the independent estimates for preceding years. Estimates with east model had the lowest estimates. The estimation of under-five mortality shows similarity in comparisons. Some direct and indirect estimates are alike with the estimates of the study.

Comparisons for sexes and regions have similar trends; the general pattern of the estimates of the thesis has a lower mortality than the other estimates. But the results for the last ten years are very consistent. The general variations of the mortality for sexes and for regions are the same.

When the two models were compared, it was seen that the use of Chilean model gives appropriate for the former periods or where the rates are high. When the rates are decreasing, two models are closing each other. The difference between the estimates is less in under-five mortality rates than infant mortality rates, relatively.

The estimates with Chilean pattern give more similar results to the other independent estimates than the estimates with the East region. However, the fast decline in the infant mortality rate and the under-five mortality rate continues. That means the pattern of the early age mortality is changing and the life conditions are increasing. Chilean model were giving more consistent results than the East model for especially high infant mortality rates, when the mortality rate is decreasing the estimates are closing each other. Therefore, the decline is continuing, for near period estimates or the future estimates of early age the East model behaves very similar with Chilean may be better for future. But for past estimates with high rates Chilean is preferable.

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## APPENDIX I

TABLE 1. LIFE TABLE $l_x$ VALUES FOR ODD AGES UP TO AGE 25 FOR EAST MODEL - FEMALES

| LEVEL | 1 | 3 | 5 | 7 | 9 | 11 |
|---|---|---|---|---|---|---|
| **6** | 0.71859 | 0.63574 | 0.60828 | 0.59714 | 0.58599 | 0.57740 |
| **7** | 0.74167 | 0.66418 | 0.63849 | 0.62787 | 0.61725 | 0.60904 |
| **8** | 0.76326 | 0.69124 | 0.66736 | 0.65731 | 0.64726 | 0.63947 |
| **9** | 0.78532 | 0.71702 | 0.69497 | 0.68554 | 0.67611 | 0.66877 |
| **10** | 0.80258 | 0.74163 | 0.72142 | 0.71264 | 0.70385 | 0.69699 |
| **11** | 0.82040 | 0.76586 | 0.74777 | 0.73973 | 0.73170 | 0.72537 |
| **12** | 0.83700 | 0.78879 | 0.77280 | 0.76554 | 0.75827 | 0.75251 |
| **13** | 0.85297 | 0.81071 | 0.79670 | 0.79020 | 0.78369 | 0.77851 |
| **14** | 0.86631 | 0.83166 | 0.81952 | 0.81376 | 0.80801 | 0.80339 |
| **15** | 0.88302 | 0.85168 | 0.84129 | 0.83627 | 0.83125 | 0.82719 |
| **16** | 0.89710 | 0.87080 | 0.86208 | 0.85778 | 0.85348 | 0.84998 |
| **17** | 0.91058 | 0.88926 | 0.88194 | 0.87834 | 0.87475 | 0.87179 |
| **18** | 0.92343 | 0.90684 | 0.90092 | 0.89801 | 0.89510 | 0.89268 |
| **19** | 0.93567 | 0.92354 | 0.91905 | 0.91682 | 0.91459 | 0.91269 |
| **20** | 0.94732 | 0.93942 | 0.93638 | 0.93481 | 0.93324 | 0.93187 |
| **21** | 0.95907 | 0.95384 | 0.95176 | 0.95065 | 0.94954 | 0.94856 |
| **22** | 0.96937 | 0.96611 | 0.96478 | 0.96405 | 0.96332 | 0.96266 |
| **23** | 0.97856 | 0.97675 | 0.97599 | 0.97556 | 0.97513 | 0.97473 |
| **24** | 0.98640 | 0.98554 | 0.98517 | 0.98495 | 0.98473 | 0.98452 |

TABLE 1. LIFE TABLE $l_x$ VALUES FOR ODD AGES UP TO AGE 25 FOR EAST MODEL – FEMALES (CONTINUED)

| **13** | **15** | **17** | **19** | **21** | **23** | **25** |
|---|---|---|---|---|---|---|
| 0.57136 | 0.56532 | 0.55738 | 0.54945 | 0.54048 | 0.53049 | 0.52050 |
| 0.60324 | 0.59744 | 0.58977 | 0.58210 | 0.57343 | 0.56374 | 0.55405 |
| 0.63394 | 0.62841 | 0.62105 | 0.61370 | 0.60535 | 0.59602 | 0.58669 |
| 0.66352 | 0.65828 | 0.65128 | 0.64427 | 0.63631 | 0.62738 | 0.61846 |
| 0.69206 | 0.68713 | 0.68051 | 0.67388 | 0.66633 | 0.65786 | 0.64938 |
| 0.72074 | 0.71612 | 0.70982 | 0.70351 | 0.69631 | 0.68821 | 0.68011 |
| 0.74826 | 0.74401 | 0.73817 | 0.73234 | 0.72565 | 0.71810 | 0.71056 |
| 0.77464 | 0.77077 | 0.76541 | 0.76006 | 0.75390 | 0.74694 | 0.73998 |
| 0.79991 | 0.79643 | 0.79157 | 0.78670 | 0.78109 | 0.77474 | 0.76838 |
| 0.82410 | 0.82101 | 0.81665 | 0.81228 | 0.80723 | 0.80150 | 0.79576 |
| 0.84727 | 0.84457 | 0.84071 | 0.83684 | 0.83236 | 0.82725 | 0.82214 |
| 0.86948 | 0.86716 | 0.86380 | 0.86044 | 0.85652 | 0.85205 | 0.84758 |
| 0.89075 | 0.88881 | 0.88595 | 0.88309 | 0.87974 | 0.87591 | 0.87207 |
| 0.91113 | 0.90957 | 0.90721 | 0.90485 | 0.90207 | 0.89886 | 0.89566 |
| 0.93068 | 0.92949 | 0.92762 | 0.92575 | 0.92352 | 0.92095 | 0.91838 |
| 0.94770 | 0.94684 | 0.94550 | 0.94416 | 0.94255 | 0.94068 | 0.93881 |
| 0.96207 | 0.96148 | 0.96053 | 0.95958 | 0.95843 | 0.95708 | 0.95574 |
| 0.97436 | 0.97398 | 0.97336 | 0.97274 | 0.97199 | 0.97110 | 0.97021 |
| 0.98431 | 0.98410 | 0.98375 | 0.98340 | 0.98296 | 0.98244 | 0.98192 |

TABLE 2. LIFE TABLE $l_x$ VALUES FOR ODD AGES UP TO AGE 25 FOR EAST MODEL - MALES

| **LEVEL** | **1** | **3** | **5** | **7** | **9** | **11** |
|---|---|---|---|---|---|---|
| **6** | 0.66686 | 0.58857 | 0.56330 | 0.55334 | 0.54339 | 0.53611 |
| **7** | 0.69396 | 0.62008 | 0.59624 | 0.58664 | 0.57705 | 0.57001 |
| **8** | 0.71931 | 0.65009 | 0.62775 | 0.61858 | 0.60941 | 0.60265 |
| **9** | 0.74309 | 0.67872 | 0.65794 | 0.64925 | 0.64056 | 0.63411 |
| **10** | 0.76547 | 0.70608 | 0.68691 | 0.67873 | 0.67056 | 0.66446 |
| **11** | 0.78641 | 0.73302 | 0.71519 | 0.70789 | 0.70060 | 0.69503 |
| **12** | 0.80562 | 0.75797 | 0.74259 | 0.73565 | 0.72870 | 0.72340 |
| **13** | 0.82416 | 0.78201 | 0.76841 | 0.76207 | 0.75573 | 0.75084 |
| **14** | 0.84204 | 0.80516 | 0.79326 | 0.78754 | 0.78182 | 0.77736 |
| **15** | 0.85923 | 0.82742 | 0.81715 | 0.81206 | 0.80697 | 0.80295 |
| **16** | 0.87574 | 0.84879 | 0.84009 | 0.83564 | 0.83119 | 0.82762 |
| **17** | 0.89158 | 0.86933 | 0.86214 | 0.85832 | 0.85450 | 0.85138 |
| **18** | 0.90672 | 0.88918 | 0.88329 | 0.88011 | 0.87692 | 0.87426 |
| **19** | 0.92117 | 0.90827 | 0.90357 | 0.90101 | 0.89846 | 0.89625 |
| **20** | 0.93494 | 0.92637 | 0.92300 | 0.92107 | 0.91914 | 0.91739 |
| **21** | 0.94857 | 0.94271 | 0.94023 | 0.93873 | 0.93724 | 0.93584 |
| **22** | 0.96108 | 0.95738 | 0.95571 | 0.95466 | 0.95361 | 0.95258 |
| **23** | 0.97240 | 0.97029 | 0.96928 | 0.96860 | 0.96793 | 0.96722 |
| **24** | 0.98218 | 0.98115 | 0.98064 | 0.98025 | 0.97986 | 0.97943 |

TABLE 2. LIFE TABLE $l_x$ VALUES FOR ODD AGES UP TO AGE 25 FOR EAST MODEL – MALES (CONTINUED)

| **13** | **15** | **17** | **19** | **21** | **23** | **25** |
|---|---|---|---|---|---|---|
| 0.53152 | 0.52692 | 0.52005 | 0.51318 | 0.50489 | 0.49518 | 0.48547 |
| 0.56552 | 0.56103 | 0.55427 | 0.54752 | 0.53935 | 0.52978 | 0.52020 |
| 0.59830 | 0.59395 | 0.58735 | 0.58074 | 0.57275 | 0.56338 | 0.55400 |
| 0.62992 | 0.62573 | 0.61932 | 0.61291 | 0.60514 | 0.59602 | 0.58690 |
| 0.66045 | 0.65643 | 0.65024 | 0.64405 | 0.63655 | 0.62774 | 0.61892 |
| 0.69118 | 0.68733 | 0.68133 | 0.67533 | 0.66806 | 0.65953 | 0.65100 |
| 0.71975 | 0.71610 | 0.71034 | 0.70458 | 0.69760 | 0.68940 | 0.68120 |
| 0.74741 | 0.74398 | 0.73850 | 0.73301 | 0.72636 | 0.71855 | 0.71073 |
| 0.77417 | 0.77097 | 0.76579 | 0.76061 | 0.75433 | 0.74694 | 0.73955 |
| 0.80000 | 0.79705 | 0.79221 | 0.78736 | 0.78148 | 0.77455 | 0.76763 |
| 0.82493 | 0.82224 | 0.81775 | 0.81326 | 0.80780 | 0.80137 | 0.79495 |
| 0.84897 | 0.84655 | 0.84243 | 0.83831 | 0.83330 | 0.82741 | 0.82151 |
| 0.87211 | 0.86997 | 0.86624 | 0.86251 | 0.85797 | 0.85262 | 0.84728 |
| 0.89438 | 0.89252 | 0.88918 | 0.88584 | 0.88178 | 0.87701 | 0.87223 |
| 0.91580 | 0.91422 | 0.91128 | 0.90835 | 0.90478 | 0.90058 | 0.89638 |
| 0.93455 | 0.93325 | 0.93079 | 0.92833 | 0.92535 | 0.92184 | 0.91834 |
| 0.95157 | 0.95056 | 0.94858 | 0.94661 | 0.94421 | 0.94139 | 0.93857 |
| 0.96649 | 0.96576 | 0.96426 | 0.96275 | 0.96093 | 0.95879 | 0.95665 |
| 0.97895 | 0.97847 | 0.97742 | 0.97637 | 0.97491 | 0.97306 | 0.97120 |

TABLE 3. LIFE TABLE $l_x$ VALUES FOR ODD AGES UP TO AGE 25 FOR EAST MODEL – BOTH SEXES

| LEVEL | 1 | 3 | 5 | 7 | 9 | 11 |
|---|---|---|---|---|---|---|
| **6** | 0.69209 | 0.61157 | 0.58524 | 0.57470 | 0.56417 | 0.55625 |
| **7** | 0.71723 | 0.64159 | 0.61684 | 0.60675 | 0.59666 | 0.58905 |
| **8** | 0.74074 | 0.67016 | 0.64707 | 0.63747 | 0.62787 | 0.62061 |
| **9** | 0.76281 | 0.69740 | 0.67600 | 0.66695 | 0.65790 | 0.65102 |
| **10** | 0.78357 | 0.72342 | 0.70374 | 0.69527 | 0.68680 | 0.68033 |
| **11** | 0.80299 | 0.74903 | 0.73138 | 0.72360 | 0.71583 | 0.70983 |
| **12** | 0.82092 | 0.77300 | 0.75732 | 0.75022 | 0.74312 | 0.73760 |
| **13** | 0.83821 | 0.79600 | 0.78220 | 0.77578 | 0.76936 | 0.76433 |
| **14** | 0.85485 | 0.81808 | 0.80606 | 0.80032 | 0.79459 | 0.79005 |
| **15** | 0.87083 | 0.83925 | 0.82892 | 0.82386 | 0.81881 | 0.81477 |
| **16** | 0.88615 | 0.85952 | 0.85081 | 0.84643 | 0.84206 | 0.83852 |
| **17** | 0.90084 | 0.87905 | 0.87179 | 0.86808 | 0.86437 | 0.86134 |
| **18** | 0.91487 | 0.89779 | 0.89188 | 0.88883 | 0.88578 | 0.88324 |
| **19** | 0.92824 | 0.91571 | 0.91112 | 0.90872 | 0.90632 | 0.90426 |
| **20** | 0.94097 | 0.93273 | 0.92952 | 0.92777 | 0.92602 | 0.92444 |
| **21** | 0.95369 | 0.94813 | 0.94585 | 0.94454 | 0.94323 | 0.94204 |
| **22** | 0.96512 | 0.96163 | 0.96013 | 0.95923 | 0.95834 | 0.95749 |
| **23** | 0.97540 | 0.97344 | 0.97255 | 0.97199 | 0.97144 | 0.96948 |
| **24** | 0.98423 | 0.98329 | 0.98284 | 0.98254 | 0.98223 | 0.98191 |

TABLE 3. LIFE TABLE $l_x$ VALUES FOR ODD AGES UP TO AGE 25 FOR EAST MODEL – BOTH SEXES (CONTINUED)

| **13** | **15** | **17** | **19** | **21** | **23** | **25** |
|---|---|---|---|---|---|---|
| 0.55095 | 0.54565 | 0.53826 | 0.53087 | 0.52225 | 0.51240 | 0.50255 |
| 0.58392 | 0.57879 | 0.57159 | 0.56438 | 0.55597 | 0.54634 | 0.53671 |
| 0.61568 | 0.61075 | 0.60378 | 0.59681 | 0.58865 | 0.57930 | 0.56994 |
| 0.64631 | 0.64160 | 0.63490 | 0.62820 | 0.62034 | 0.61131 | 0.60229 |
| 0.67586 | 0.67140 | 0.66500 | 0.65860 | 0.65107 | 0.64242 | 0.63377 |
| 0.70560 | 0.70137 | 0.69522 | 0.68907 | 0.68184 | 0.67351 | 0.66519 |
| 0.73365 | 0.72971 | 0.72391 | 0.71812 | 0.71128 | 0.70340 | 0.69552 |
| 0.76068 | 0.75704 | 0.75162 | 0.74620 | 0.73979 | 0.73239 | 0.72499 |
| 0.78672 | 0.78338 | 0.77836 | 0.77333 | 0.76738 | 0.76049 | 0.75361 |
| 0.81175 | 0.80873 | 0.80412 | 0.79951 | 0.79404 | 0.78769 | 0.78135 |
| 0.83583 | 0.83313 | 0.82894 | 0.82475 | 0.81977 | 0.81399 | 0.80821 |
| 0.85897 | 0.85660 | 0.85285 | 0.84910 | 0.84463 | 0.83942 | 0.83422 |
| 0.88119 | 0.87915 | 0.87585 | 0.87254 | 0.86859 | 0.86398 | 0.85937 |
| 0.90255 | 0.90083 | 0.89797 | 0.89511 | 0.89167 | 0.88766 | 0.88365 |
| 0.92305 | 0.92166 | 0.91924 | 0.91683 | 0.91392 | 0.91051 | 0.90711 |
| 0.94095 | 0.93987 | 0.93796 | 0.93605 | 0.93374 | 0.93103 | 0.92832 |
| 0.95668 | 0.95588 | 0.95440 | 0.95293 | 0.95114 | 0.94904 | 0.94694 |
| 0.96612 | 0.96276 | 0.96449 | 0.96622 | 0.96632 | 0.96479 | 0.96326 |
| 0.98156 | 0.98121 | 0.98050 | 0.97979 | 0.97892 | 0.97791 | 0.97689 |

TABLE 4. LIFE TABLE $l_x$ VALUES FOR ODD AGES UP TO AGE 25 FOR CHILEAN MODEL – FEMALES

| AGE | **1** | **3** | **5** | **7** | **9** | **11** |
|---|---|---|---|---|---|---|
| 35 | 0.78168 | 0.71085 | 0.68620 | 0.67694 | 0.66767 | 0.65961 |
| 36 | 0.78713 | 0.71919 | 0.69555 | 0.68665 | 0.67776 | 0.67001 |
| 37 | 0.79250 | 0.72737 | 0.70472 | 0.69618 | 0.68765 | 0.68020 |
| 38 | 0.79780 | 0.73542 | 0.71374 | 0.70555 | 0.69736 | 0.69021 |
| 39 | 0.80303 | 0.74331 | 0.72257 | 0.71473 | 0.70689 | 0.70004 |
| 40 | 0.80820 | 0.75108 | 0.73127 | 0.72377 | 0.71626 | 0.70969 |
| 41 | 0.81331 | 0.75872 | 0.73980 | 0.73263 | 0.72546 | 0.71917 |
| 42 | 0.81837 | 0.76625 | 0.74820 | 0.74134 | 0.73449 | 0.72847 |
| 43 | 0.82337 | 0.77365 | 0.75645 | 0.74991 | 0.74337 | 0.73763 |
| 44 | 0.82832 | 0.78094 | 0.76457 | 0.75833 | 0.75210 | 0.74661 |
| 45 | 0.83323 | 0.78812 | 0.77256 | 0.76662 | 0.76068 | 0.75545 |
| 46 | 0.83808 | 0.79519 | 0.78041 | 0.77476 | 0.76911 | 0.76414 |
| 47 | 0.84290 | 0.80216 | 0.78814 | 0.78277 | 0.77740 | 0.77267 |
| 48 | 0.84767 | 0.80903 | 0.79574 | 0.79065 | 0.78556 | 0.78106 |
| 49 | 0.85241 | 0.81580 | 0.80323 | 0.79841 | 0.79358 | 0.78932 |
| 50 | 0.85710 | 0.82247 | 0.81059 | 0.80603 | 0.80146 | 0.79743 |
| 51 | 0.86176 | 0.82904 | 0.81784 | 0.81353 | 0.80922 | 0.80540 |
| 52 | 0.86637 | 0.83551 | 0.82496 | 0.82090 | 0.81683 | 0.81323 |
| 53 | 0.87096 | 0.84190 | 0.83198 | 0.82815 | 0.82432 | 0.82093 |
| 54 | 0.87551 | 0.84819 | 0.83889 | 0.83529 | 0.83169 | 0.82849 |
| 55 | 0.88002 | 0.85439 | 0.84567 | 0.84230 | 0.83893 | 0.83593 |
| 56 | 0.88450 | 0.86050 | 0.85235 | 0.84919 | 0.84604 | 0.84323 |
| 57 | 0.88894 | 0.86651 | 0.85891 | 0.85596 | 0.85301 | 0.85039 |
| 58 | 0.89335 | 0.87244 | 0.86537 | 0.86262 | 0.85987 | 0.85742 |
| 59 | 0.89772 | 0.87827 | 0.87170 | 0.86915 | 0.86660 | 0.86432 |
| 60 | 0.90205 | 0.88401 | 0.87793 | 0.87557 | 0.87320 | 0.87109 |
| 61 | 0.90635 | 0.88966 | 0.88404 | 0.88186 | 0.87967 | 0.87772 |
| 62 | 0.91062 | 0.89522 | 0.89006 | 0.88804 | 0.88602 | 0.88421 |
| 63 | 0.91484 | 0.90068 | 0.89594 | 0.89408 | 0.89223 | 0.89057 |
| 64 | 0.91901 | 0.90603 | 0.90170 | 0.90000 | 0.89831 | 0.89678 |
| 65 | 0.92314 | 0.91129 | 0.90734 | 0.90579 | 0.90424 | 0.90285 |
| 66 | 0.92722 | 0.91644 | 0.91286 | 0.91145 | 0.91004 | 0.90878 |
| 67 | 0.93125 | 0.92148 | 0.91824 | 0.91697 | 0.91570 | 0.91455 |
| 68 | 0.93522 | 0.92641 | 0.92349 | 0.92235 | 0.92120 | 0.92017 |
| 69 | 0.93914 | 0.93123 | 0.92862 | 0.92759 | 0.92656 | 0.92564 |
| 70 | 0.94298 | 0.93592 | 0.93360 | 0.93268 | 0.93177 | 0.93094 |
| 71 | 0.94676 | 0.94049 | 0.93843 | 0.93762 | 0.93681 | 0.93607 |
| 72 | 0.95046 | 0.94493 | 0.94311 | 0.94240 | 0.94169 | 0.94104 |
| 73 | 0.95409 | 0.94923 | 0.94765 | 0.94702 | 0.94639 | 0.94582 |
| 74 | 0.95762 | 0.95339 | 0.95202 | 0.95148 | 0.95093 | 0.95044 |
| 75 | 0.96105 | 0.95740 | 0.95622 | 0.95575 | 0.95528 | 0.95485 |

TABLE 4. LIFE TABLE $l_x$ VALUES FOR ODD AGES UP TO AGE 25 FOR CHILEAN MODEL – FEMALES (CONTINUED)

| 13 | 15 | 17 | 19 | 21 | 23 | 25 |
|---|---|---|---|---|---|---|
| 0.65274 | 0.64588 | 0.63423 | 0.62258 | 0.60876 | 0.59275 | 0.57674 |
| 0.66340 | 0.65679 | 0.64557 | 0.63435 | 0.62101 | 0.60554 | 0.59008 |
| 0.67385 | 0.66749 | 0.65669 | 0.64590 | 0.63304 | 0.61812 | 0.60320 |
| 0.68410 | 0.67799 | 0.66761 | 0.65724 | 0.64486 | 0.63047 | 0.61609 |
| 0.69417 | 0.68830 | 0.67834 | 0.66837 | 0.65647 | 0.64262 | 0.62878 |
| 0.70406 | 0.69842 | 0.68886 | 0.67931 | 0.66787 | 0.65456 | 0.64125 |
| 0.71376 | 0.70836 | 0.69921 | 0.69006 | 0.67909 | 0.66630 | 0.65352 |
| 0.72330 | 0.71813 | 0.70937 | 0.70061 | 0.69010 | 0.67783 | 0.66557 |
| 0.73268 | 0.72773 | 0.71935 | 0.71098 | 0.70092 | 0.68917 | 0.67742 |
| 0.74188 | 0.73715 | 0.72915 | 0.72116 | 0.71154 | 0.70031 | 0.68907 |
| 0.75094 | 0.74642 | 0.73880 | 0.73117 | 0.72199 | 0.71126 | 0.70053 |
| 0.75983 | 0.75553 | 0.74827 | 0.74100 | 0.73225 | 0.72202 | 0.71178 |
| 0.76858 | 0.76448 | 0.75757 | 0.75066 | 0.74233 | 0.73258 | 0.72283 |
| 0.77717 | 0.77327 | 0.76671 | 0.76015 | 0.75223 | 0.74296 | 0.73369 |
| 0.78561 | 0.78191 | 0.77569 | 0.76948 | 0.76197 | 0.75316 | 0.74435 |
| 0.79392 | 0.79041 | 0.78452 | 0.77863 | 0.77152 | 0.76317 | 0.75482 |
| 0.80207 | 0.79875 | 0.79319 | 0.78762 | 0.78089 | 0.77299 | 0.76509 |
| 0.81009 | 0.80695 | 0.80170 | 0.79645 | 0.79009 | 0.78263 | 0.77517 |
| 0.81796 | 0.81500 | 0.81006 | 0.80511 | 0.79912 | 0.79209 | 0.78506 |
| 0.82570 | 0.82291 | 0.81826 | 0.81361 | 0.80798 | 0.80137 | 0.79475 |
| 0.83330 | 0.83068 | 0.82632 | 0.82196 | 0.81667 | 0.81046 | 0.80425 |
| 0.84076 | 0.83830 | 0.83422 | 0.83014 | 0.82519 | 0.81937 | 0.81355 |
| 0.84808 | 0.84578 | 0.84197 | 0.83816 | 0.83353 | 0.82810 | 0.82266 |
| 0.85527 | 0.85311 | 0.84956 | 0.84601 | 0.84170 | 0.83663 | 0.83156 |
| 0.86231 | 0.86031 | 0.85701 | 0.85370 | 0.84969 | 0.84498 | 0.84027 |
| 0.86922 | 0.86736 | 0.86430 | 0.86124 | 0.85753 | 0.85316 | 0.84879 |
| 0.87599 | 0.87426 | 0.87144 | 0.86861 | 0.86518 | 0.86115 | 0.85711 |
| 0.88262 | 0.88102 | 0.87842 | 0.87581 | 0.87265 | 0.86894 | 0.86522 |
| 0.88910 | 0.88763 | 0.88524 | 0.88285 | 0.87994 | 0.87653 | 0.87312 |
| 0.89543 | 0.89408 | 0.89190 | 0.88971 | 0.88706 | 0.88393 | 0.88081 |
| 0.90162 | 0.90039 | 0.89839 | 0.89640 | 0.89398 | 0.89113 | 0.88829 |
| 0.90765 | 0.90653 | 0.90472 | 0.90291 | 0.90072 | 0.89813 | 0.89555 |
| 0.91353 | 0.91251 | 0.91087 | 0.90924 | 0.90725 | 0.90492 | 0.90259 |
| 0.91925 | 0.91833 | 0.91686 | 0.91539 | 0.91360 | 0.91151 | 0.90941 |
| 0.92481 | 0.92398 | 0.92266 | 0.92135 | 0.91975 | 0.91787 | 0.91599 |
| 0.93019 | 0.92945 | 0.92828 | 0.92711 | 0.92569 | 0.92402 | 0.92235 |
| 0.93541 | 0.93475 | 0.93371 | 0.93268 | 0.93142 | 0.92995 | 0.92847 |
| 0.94045 | 0.93987 | 0.93896 | 0.93805 | 0.93694 | 0.93565 | 0.93435 |
| 0.94531 | 0.94480 | 0.94400 | 0.94321 | 0.94224 | 0.94111 | 0.93998 |
| 0.94999 | 0.94954 | 0.94885 | 0.94816 | 0.94732 | 0.94634 | 0.94536 |
| 0.95446 | 0.95408 | 0.95348 | 0.95289 | 0.95217 | 0.95132 | 0.95048 |

TABLE 5. LIFE TABLE $l_x$ VALUES FOR ODD AGES UP TO AGE 25 FOR CHILEAN MODEL – MALES

| AGE | **1** | **3** | **5** | **7** | **9** | **11** |
|---|---|---|---|---|---|---|
| 35 | 0.76131 | 0.72468 | 0.68648 | 0.67865 | 0.67082 | 0.66412 |
| 36 | 0.76865 | 0.73372 | 0.69723 | 0.68972 | 0.68221 | 0.67575 |
| 37 | 0.77587 | 0.74259 | 0.70777 | 0.70056 | 0.69335 | 0.68714 |
| 38 | 0.78298 | 0.75130 | 0.71810 | 0.71119 | 0.70428 | 0.69831 |
| 39 | 0.78997 | 0.75985 | 0.72823 | 0.72161 | 0.71499 | 0.70926 |
| 40 | 0.79686 | 0.76824 | 0.73815 | 0.73182 | 0.72549 | 0.72000 |
| 41 | 0.80364 | 0.77648 | 0.74788 | 0.74183 | 0.73578 | 0.73052 |
| 42 | 0.81032 | 0.78458 | 0.75742 | 0.75165 | 0.74588 | 0.74084 |
| 43 | 0.81690 | 0.79252 | 0.76678 | 0.76128 | 0.75577 | 0.75096 |
| 44 | 0.82339 | 0.80033 | 0.77595 | 0.77071 | 0.76547 | 0.76088 |
| 45 | 0.82978 | 0.80801 | 0.78494 | 0.77996 | 0.77497 | 0.77059 |
| 46 | 0.83607 | 0.81554 | 0.79375 | 0.79272 | 0.79169 | 0.78946 |
| 47 | 0.84228 | 0.82294 | 0.80239 | 0.80153 | 0.80067 | 0.79860 |
| 48 | 0.84839 | 0.83021 | 0.81085 | 0.81015 | 0.80946 | 0.80755 |
| 49 | 0.85442 | 0.83735 | 0.81915 | 0.81861 | 0.81808 | 0.81633 |
| 50 | 0.86036 | 0.84437 | 0.82728 | 0.82689 | 0.82650 | 0.82490 |
| 51 | 0.86620 | 0.85124 | 0.83523 | 0.83499 | 0.83476 | 0.83331 |
| 52 | 0.87197 | 0.85800 | 0.84303 | 0.84293 | 0.84283 | 0.84152 |
| 53 | 0.87764 | 0.86463 | 0.85065 | 0.85069 | 0.85072 | 0.84955 |
| 54 | 0.88323 | 0.87113 | 0.85812 | 0.85828 | 0.85844 | 0.85740 |
| 55 | 0.88872 | 0.87750 | 0.86541 | 0.86569 | 0.86598 | 0.86507 |
| 56 | 0.89413 | 0.88375 | 0.87255 | 0.87295 | 0.87334 | 0.87256 |
| 57 | 0.89945 | 0.88988 | 0.87952 | 0.88002 | 0.88053 | 0.87986 |
| 58 | 0.90468 | 0.89588 | 0.88632 | 0.88898 | 0.89163 | 0.89194 |
| 59 | 0.90981 | 0.90174 | 0.89296 | 0.89366 | 0.89436 | 0.89391 |
| 60 | 0.91485 | 0.90748 | 0.89943 | 0.90021 | 0.90100 | 0.90065 |
| 61 | 0.91979 | 0.91308 | 0.90574 | 0.90660 | 0.90746 | 0.90721 |
| 62 | 0.92463 | 0.91854 | 0.91186 | 0.91027 | 0.90868 | 0.90721 |
| 63 | 0.92937 | 0.92387 | 0.91782 | 0.91637 | 0.91492 | 0.91356 |
| 64 | 0.93399 | 0.92904 | 0.92358 | 0.92226 | 0.92095 | 0.91971 |
| 65 | 0.93850 | 0.93407 | 0.92917 | 0.92798 | 0.92679 | 0.92567 |
| 66 | 0.94290 | 0.93896 | 0.93457 | 0.93350 | 0.93243 | 0.93141 |
| 67 | 0.94718 | 0.94369 | 0.93979 | 0.93883 | 0.93787 | 0.93696 |
| 68 | 0.95132 | 0.94825 | 0.94481 | 0.94395 | 0.94310 | 0.94228 |
| 69 | 0.95534 | 0.95265 | 0.94964 | 0.94888 | 0.94812 | 0.94739 |
| 70 | 0.95921 | 0.95688 | 0.95425 | 0.95359 | 0.95292 | 0.95228 |
| 71 | 0.96294 | 0.96093 | 0.95865 | 0.95807 | 0.95750 | 0.95694 |
| 72 | 0.96652 | 0.96481 | 0.96286 | 0.96236 | 0.96185 | 0.96136 |
| 73 | 0.96994 | 0.96850 | 0.96684 | 0.96640 | 0.96597 | 0.96554 |
| 74 | 0.97319 | 0.97198 | 0.97058 | 0.97021 | 0.96984 | 0.96948 |
| 75 | 0.97626 | 0.97526 | 0.97410 | 0.97379 | 0.97348 | 0.97318 |

TABLE 5. LIFE TABLE $l_x$ VALUES FOR ODD AGES UP TO AGE 25 FOR CHILEAN MODEL – MALES (CONTINUED)

| **13** | **15** | **17** | **19** | **21** | **23** | **25** |
|---|---|---|---|---|---|---|
| 0.65853 | 0.65295 | 0.64408 | 0.63521 | 0.62435 | 0.61150 | 0.59865 |
| 0.67035 | 0.66495 | 0.65635 | 0.64774 | 0.63719 | 0.62468 | 0.61217 |
| 0.68193 | 0.67672 | 0.66838 | 0.66004 | 0.64979 | 0.63763 | 0.62547 |
| 0.69328 | 0.68826 | 0.68018 | 0.67211 | 0.66217 | 0.65036 | 0.63855 |
| 0.70443 | 0.69959 | 0.69177 | 0.68396 | 0.67432 | 0.66287 | 0.65141 |
| 0.71535 | 0.71069 | 0.70313 | 0.69558 | 0.68625 | 0.67516 | 0.66406 |
| 0.72605 | 0.72157 | 0.71428 | 0.70699 | 0.69797 | 0.68724 | 0.67650 |
| 0.73655 | 0.73225 | 0.72522 | 0.71819 | 0.70948 | 0.69910 | 0.68872 |
| 0.74683 | 0.74271 | 0.73594 | 0.72917 | 0.72078 | 0.71076 | 0.70074 |
| 0.75693 | 0.75298 | 0.74646 | 0.73995 | 0.73186 | 0.72220 | 0.71254 |
| 0.76682 | 0.76304 | 0.75678 | 0.75052 | 0.74274 | 0.73344 | 0.72414 |
| 0.78601 | 0.78256 | 0.77681 | 0.77106 | 0.76389 | 0.75530 | 0.74671 |
| 0.79531 | 0.79203 | 0.78653 | 0.78102 | 0.77415 | 0.76592 | 0.75768 |
| 0.80443 | 0.80131 | 0.79605 | 0.79078 | 0.78421 | 0.77632 | 0.76844 |
| 0.81336 | 0.81039 | 0.80537 | 0.80035 | 0.79407 | 0.78654 | 0.77900 |
| 0.82209 | 0.81928 | 0.81450 | 0.80972 | 0.80373 | 0.79654 | 0.78935 |
| 0.83064 | 0.82798 | 0.82344 | 0.81889 | 0.81319 | 0.80634 | 0.79949 |
| 0.83901 | 0.83649 | 0.83217 | 0.82786 | 0.82244 | 0.81593 | 0.80942 |
| 0.84718 | 0.84481 | 0.84072 | 0.83663 | 0.83150 | 0.82532 | 0.81914 |
| 0.85517 | 0.85294 | 0.84908 | 0.84521 | 0.84035 | 0.83450 | 0.82864 |
| 0.86298 | 0.86088 | 0.85723 | 0.85358 | 0.84899 | 0.84346 | 0.83793 |
| 0.87059 | 0.86863 | 0.86520 | 0.86177 | 0.85744 | 0.85223 | 0.84701 |
| 0.87803 | 0.87619 | 0.87297 | 0.86975 | 0.86569 | 0.86078 | 0.85587 |
| 0.88989 | 0.88784 | 0.88613 | 0.88442 | 0.88205 | 0.87904 | 0.87602 |
| 0.89232 | 0.89073 | 0.88791 | 0.88510 | 0.88154 | 0.87723 | 0.87292 |
| 0.89918 | 0.89771 | 0.89509 | 0.89246 | 0.88914 | 0.88512 | 0.88110 |
| 0.90584 | 0.90448 | 0.90204 | 0.89961 | 0.89652 | 0.89279 | 0.88905 |
| 0.90584 | 0.90448 | 0.90204 | 0.89961 | 0.89652 | 0.89279 | 0.88905 |
| 0.91231 | 0.91105 | 0.90879 | 0.90654 | 0.90368 | 0.90022 | 0.89676 |
| 0.91856 | 0.91741 | 0.91533 | 0.91326 | 0.91062 | 0.90743 | 0.90423 |
| 0.92462 | 0.92357 | 0.92166 | 0.91975 | 0.91733 | 0.91439 | 0.91145 |
| 0.93046 | 0.92951 | 0.92776 | 0.92601 | 0.92379 | 0.92110 | 0.91841 |
| 0.93609 | 0.93523 | 0.93364 | 0.93205 | 0.93003 | 0.92758 | 0.92512 |
| 0.94151 | 0.94073 | 0.93929 | 0.93785 | 0.93602 | 0.93379 | 0.93156 |
| 0.94670 | 0.94600 | 0.94470 | 0.94341 | 0.94176 | 0.93975 | 0.93774 |
| 0.95166 | 0.95104 | 0.94988 | 0.94872 | 0.94724 | 0.94543 | 0.94363 |
| 0.95639 | 0.95584 | 0.95481 | 0.95378 | 0.95246 | 0.95085 | 0.94924 |
| 0.96088 | 0.96040 | 0.95949 | 0.95858 | 0.95741 | 0.95598 | 0.95456 |
| 0.96513 | 0.96471 | 0.96391 | 0.96310 | 0.96208 | 0.96083 | 0.95958 |
| 0.96912 | 0.96876 | 0.96806 | 0.96737 | 0.96647 | 0.96538 | 0.96429 |
| 0.97287 | 0.97256 | 0.97196 | 0.97135 | 0.97058 | 0.96964 | 0.96870 |

TABLE 6. LIFE TABLE $l_x$ VALUES FOR ODD AGES UP TO AGE 25 FOR CHILEAN MODEL – BOTH SEXES

| AGE | **1** | **3** | **5** | **7** | **9** | **11** |
|---|---|---|---|---|---|---|
| 35 | 0.77125 | 0.72952 | 0.68634 | 0.67781 | 0.66928 | 0.66192 |
| 36 | 0.77766 | 0.73773 | 0.69641 | 0.68822 | 0.68003 | 0.67295 |
| 37 | 0.78398 | 0.74580 | 0.70628 | 0.69842 | 0.69057 | 0.68376 |
| 38 | 0.79021 | 0.75373 | 0.71597 | 0.70844 | 0.70091 | 0.69436 |
| 39 | 0.79634 | 0.76151 | 0.72547 | 0.71825 | 0.71104 | 0.70476 |
| 40 | 0.80239 | 0.76917 | 0.73479 | 0.72789 | 0.72099 | 0.71497 |
| 41 | 0.80836 | 0.77670 | 0.74394 | 0.73734 | 0.73075 | 0.72499 |
| 42 | 0.81425 | 0.78411 | 0.75292 | 0.74662 | 0.74032 | 0.73481 |
| 43 | 0.82006 | 0.79139 | 0.76174 | 0.75573 | 0.74972 | 0.74446 |
| 44 | 0.82579 | 0.79856 | 0.77040 | 0.76467 | 0.75894 | 0.75392 |
| 45 | 0.83146 | 0.80562 | 0.77890 | 0.77345 | 0.76800 | 0.76321 |
| 46 | 0.83705 | 0.81255 | 0.78724 | 0.78396 | 0.78068 | 0.77711 |
| 47 | 0.84258 | 0.81939 | 0.79544 | 0.79238 | 0.78932 | 0.78595 |
| 48 | 0.84804 | 0.82612 | 0.80348 | 0.80064 | 0.79780 | 0.79463 |
| 49 | 0.85344 | 0.83275 | 0.81138 | 0.80875 | 0.80612 | 0.80315 |
| 50 | 0.85877 | 0.83927 | 0.81914 | 0.81672 | 0.81429 | 0.81150 |
| 51 | 0.86403 | 0.84567 | 0.82675 | 0.82453 | 0.82230 | 0.81970 |
| 52 | 0.86924 | 0.85199 | 0.83422 | 0.83218 | 0.83015 | 0.82772 |
| 53 | 0.87438 | 0.85821 | 0.84154 | 0.83969 | 0.83784 | 0.83559 |
| 54 | 0.87946 | 0.86432 | 0.84874 | 0.84706 | 0.84539 | 0.84330 |
| 55 | 0.88448 | 0.87033 | 0.85578 | 0.85428 | 0.85278 | 0.85085 |
| 56 | 0.88943 | 0.87625 | 0.86270 | 0.86136 | 0.86002 | 0.85825 |
| 57 | 0.89432 | 0.88206 | 0.86947 | 0.86829 | 0.86711 | 0.86549 |
| 58 | 0.89915 | 0.88778 | 0.87610 | 0.87612 | 0.87614 | 0.87510 |
| 59 | 0.90391 | 0.89339 | 0.88259 | 0.88170 | 0.88081 | 0.87947 |
| 60 | 0.90861 | 0.89890 | 0.88894 | 0.88819 | 0.88744 | 0.88623 |
| 61 | 0.91323 | 0.90430 | 0.89515 | 0.89453 | 0.89390 | 0.89282 |
| 62 | 0.91780 | 0.90960 | 0.90123 | 0.89943 | 0.89763 | 0.89599 |
| 63 | 0.92228 | 0.91480 | 0.90715 | 0.90550 | 0.90385 | 0.90234 |
| 64 | 0.92668 | 0.91986 | 0.91291 | 0.91141 | 0.90990 | 0.90853 |
| 65 | 0.93101 | 0.92483 | 0.91852 | 0.91716 | 0.91579 | 0.91454 |
| 66 | 0.93525 | 0.92967 | 0.92398 | 0.92274 | 0.92151 | 0.92037 |
| 67 | 0.93941 | 0.93439 | 0.92928 | 0.92817 | 0.92706 | 0.92603 |
| 68 | 0.94347 | 0.93898 | 0.93441 | 0.93341 | 0.93242 | 0.93150 |
| 69 | 0.94744 | 0.94344 | 0.93939 | 0.93850 | 0.93761 | 0.93678 |
| 70 | 0.95129 | 0.94776 | 0.94418 | 0.94339 | 0.94260 | 0.94187 |
| 71 | 0.95505 | 0.95193 | 0.94879 | 0.94810 | 0.94741 | 0.94676 |
| 72 | 0.95869 | 0.95597 | 0.95323 | 0.95262 | 0.95201 | 0.95145 |
| 73 | 0.96221 | 0.95986 | 0.95748 | 0.95695 | 0.95642 | 0.95592 |
| 74 | 0.96559 | 0.96357 | 0.96153 | 0.96107 | 0.96062 | 0.96019 |
| 75 | 0.96884 | 0.96711 | 0.96538 | 0.96499 | 0.96460 | 0.96424 |

TABLE 6. LIFE TABLE $l_x$ VALUES FOR ODD AGES UP TO AGE 25 FOR CHILEAN MODEL – BOTH SEXES (CONTINUED)

| 13 | 15 | 17 | 19 | 21 | 23 | 25 |
|---|---|---|---|---|---|---|
| 0.65571 | 0.64950 | 0.63928 | 0.62905 | 0.61674 | 0.60235 | 0.58796 |
| 0.66696 | 0.66097 | 0.65109 | 0.64121 | 0.62929 | 0.61534 | 0.60139 |
| 0.67799 | 0.67222 | 0.66268 | 0.65314 | 0.64162 | 0.62811 | 0.61461 |
| 0.68881 | 0.68325 | 0.67405 | 0.66486 | 0.65373 | 0.64066 | 0.62759 |
| 0.69942 | 0.69408 | 0.68522 | 0.67635 | 0.66561 | 0.65299 | 0.64037 |
| 0.70984 | 0.70470 | 0.69617 | 0.68764 | 0.67729 | 0.66511 | 0.65293 |
| 0.72006 | 0.71513 | 0.70693 | 0.69873 | 0.68876 | 0.67703 | 0.66529 |
| 0.73008 | 0.72536 | 0.71748 | 0.70961 | 0.70002 | 0.68873 | 0.67743 |
| 0.73993 | 0.73540 | 0.72785 | 0.72030 | 0.71109 | 0.70022 | 0.68936 |
| 0.74959 | 0.74526 | 0.73802 | 0.73078 | 0.72195 | 0.71152 | 0.70109 |
| 0.75907 | 0.75493 | 0.74801 | 0.74108 | 0.73262 | 0.72262 | 0.71262 |
| 0.77324 | 0.76937 | 0.76288 | 0.75639 | 0.74845 | 0.73906 | 0.72967 |
| 0.78227 | 0.77859 | 0.77240 | 0.76621 | 0.75863 | 0.74966 | 0.74068 |
| 0.79113 | 0.78763 | 0.78173 | 0.77584 | 0.76861 | 0.76005 | 0.75149 |
| 0.79982 | 0.79650 | 0.79090 | 0.78529 | 0.77841 | 0.77026 | 0.76210 |
| 0.80835 | 0.80520 | 0.79988 | 0.79456 | 0.78802 | 0.78027 | 0.77251 |
| 0.81671 | 0.81372 | 0.80868 | 0.80364 | 0.79744 | 0.79007 | 0.78271 |
| 0.82490 | 0.82208 | 0.81731 | 0.81254 | 0.80666 | 0.79969 | 0.79271 |
| 0.83293 | 0.83027 | 0.82576 | 0.82125 | 0.81570 | 0.80911 | 0.80252 |
| 0.84079 | 0.83829 | 0.83405 | 0.82980 | 0.82457 | 0.81834 | 0.81211 |
| 0.84850 | 0.84615 | 0.84215 | 0.83816 | 0.83323 | 0.82736 | 0.82150 |
| 0.85604 | 0.85383 | 0.85008 | 0.84633 | 0.84171 | 0.83620 | 0.83069 |
| 0.86342 | 0.86136 | 0.85785 | 0.85434 | 0.85000 | 0.84483 | 0.83967 |
| 0.87300 | 0.87090 | 0.86829 | 0.86568 | 0.86237 | 0.85835 | 0.85433 |
| 0.87768 | 0.87589 | 0.87284 | 0.86979 | 0.86601 | 0.86150 | 0.85699 |
| 0.88457 | 0.88291 | 0.88007 | 0.87723 | 0.87372 | 0.86953 | 0.86534 |
| 0.89128 | 0.88974 | 0.88712 | 0.88449 | 0.88124 | 0.87735 | 0.87347 |
| 0.89452 | 0.89304 | 0.89052 | 0.88800 | 0.88488 | 0.88115 | 0.87743 |
| 0.90099 | 0.89963 | 0.89731 | 0.89498 | 0.89210 | 0.88867 | 0.88523 |
| 0.90728 | 0.90603 | 0.90390 | 0.90177 | 0.89913 | 0.89597 | 0.89281 |
| 0.91340 | 0.91226 | 0.91031 | 0.90836 | 0.90594 | 0.90305 | 0.90015 |
| 0.91934 | 0.91830 | 0.91652 | 0.91475 | 0.91254 | 0.90990 | 0.90726 |
| 0.92509 | 0.92415 | 0.92254 | 0.92093 | 0.91892 | 0.91653 | 0.91413 |
| 0.93065 | 0.92980 | 0.92834 | 0.92689 | 0.92508 | 0.92292 | 0.92076 |
| 0.93602 | 0.93526 | 0.93395 | 0.93264 | 0.93102 | 0.92907 | 0.92713 |
| 0.94119 | 0.94051 | 0.93935 | 0.93818 | 0.93673 | 0.93499 | 0.93325 |
| 0.94615 | 0.94555 | 0.94452 | 0.94349 | 0.94220 | 0.94065 | 0.93911 |
| 0.95092 | 0.95039 | 0.94948 | 0.94857 | 0.94743 | 0.94606 | 0.94470 |
| 0.95546 | 0.95500 | 0.95420 | 0.95340 | 0.95240 | 0.95121 | 0.95002 |
| 0.95978 | 0.95938 | 0.95869 | 0.95800 | 0.95713 | 0.95610 | 0.95506 |
| 0.96389 | 0.96355 | 0.96295 | 0.96235 | 0.96160 | 0.96071 | 0.95981 |

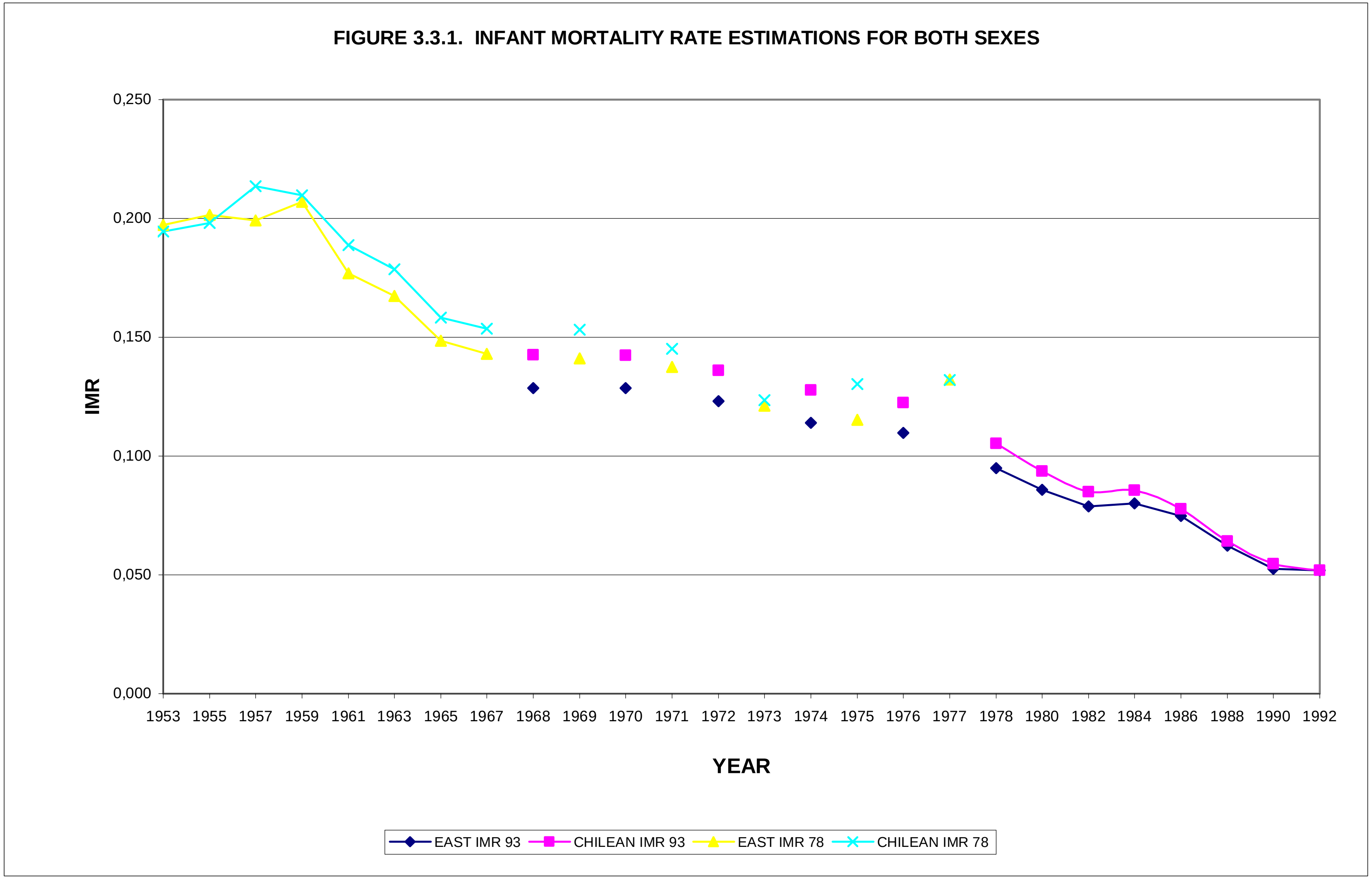


FIGURE 3.3.1. INFANT MORTALITY RATE ESTIMATIONS FOR BOTH SEXES
IMR
0,250
0,200
0,150
0,100
0,050
0,000
1953 1955 1957 1959 1961 1963 1965 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1980 1982 1984 1986 1988 1990 1992
YEAR
EAST IMR 93
CHILEAN IMR 93
EAST IMR 78
CHILEAN IMR 78

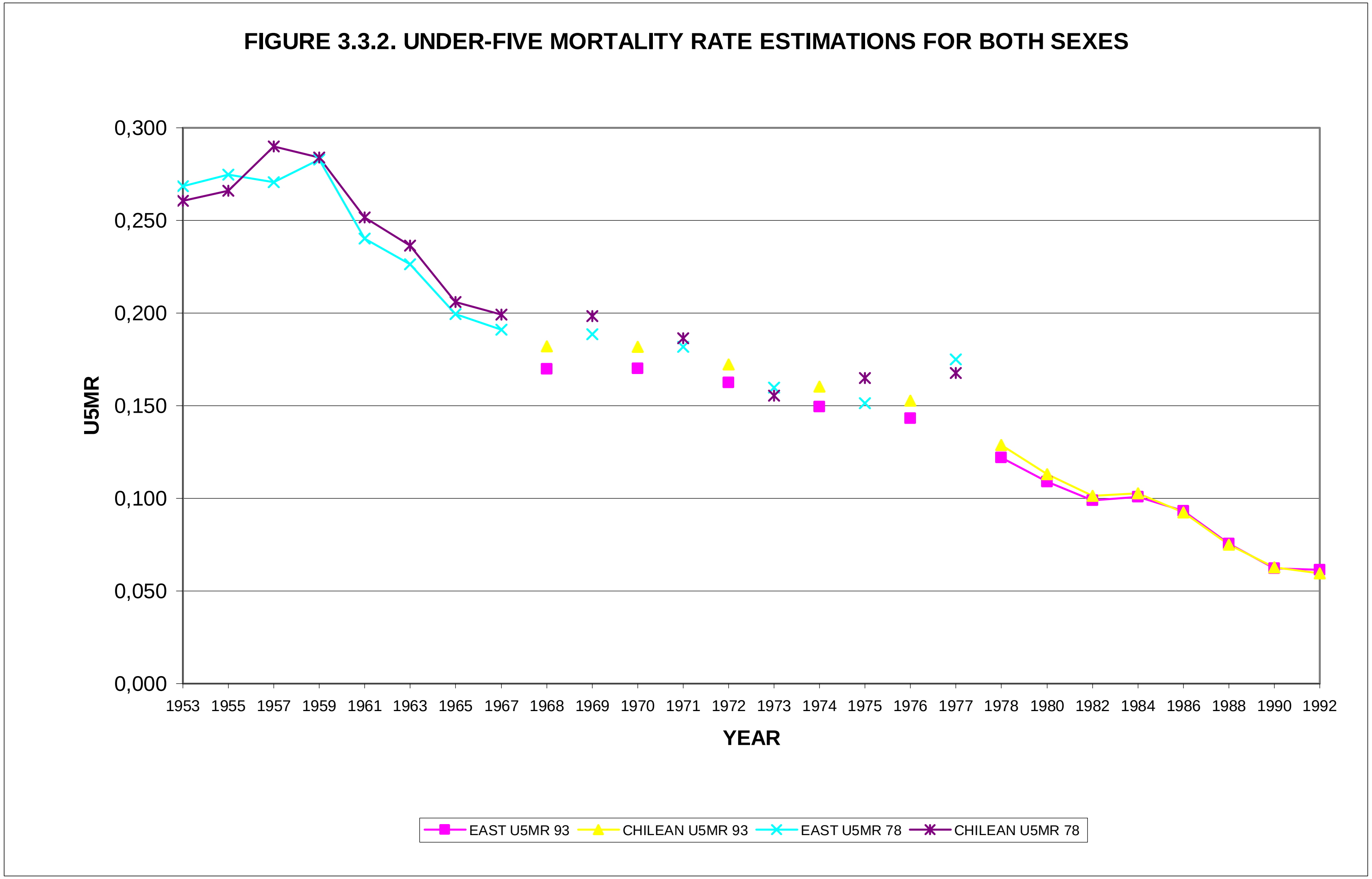
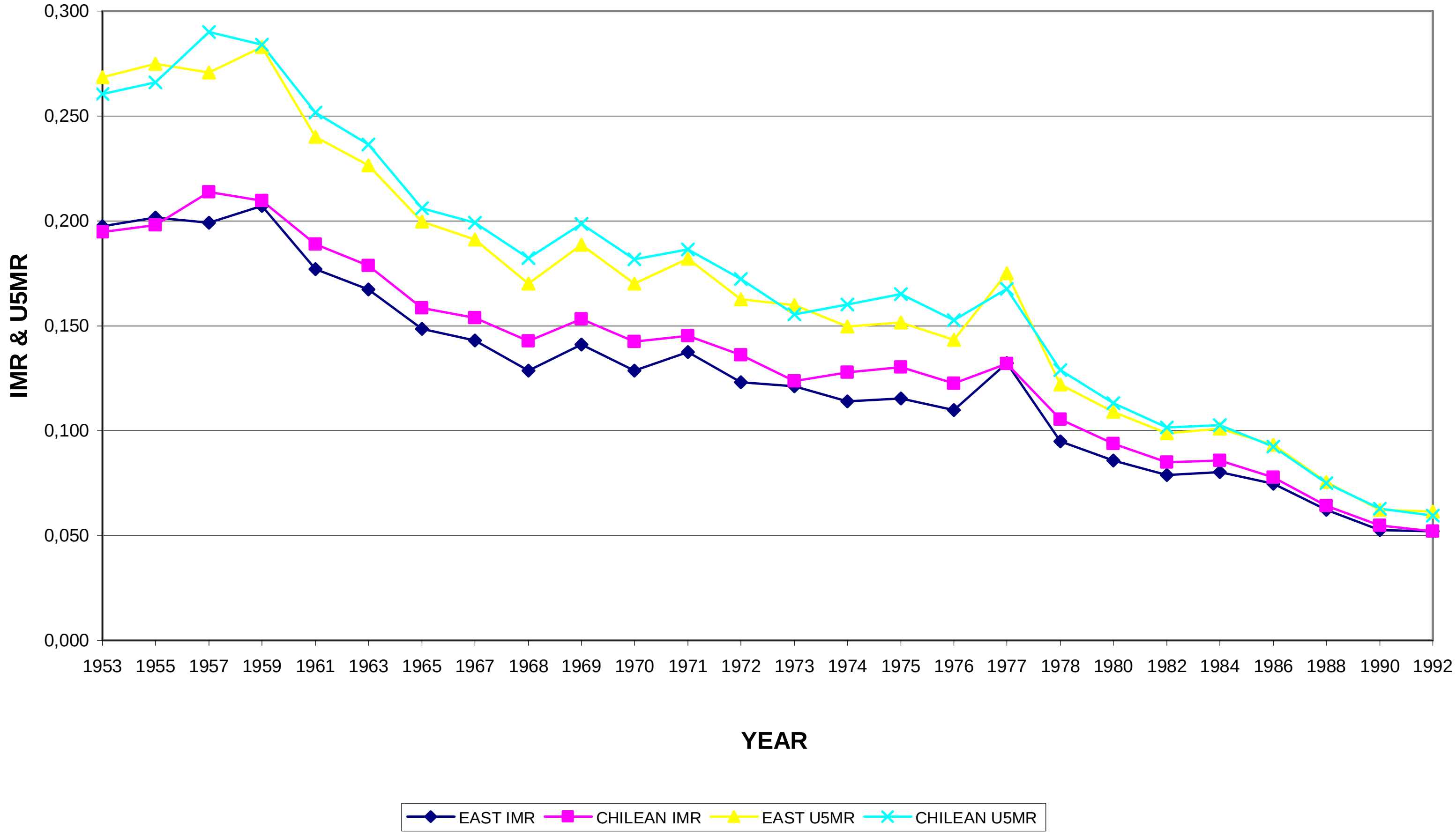


FIGURE 3.3.2. UNDER-FIVE MORTALITY RATE ESTIMATIONS FOR BOTH SEXES
U5MR
0,300
0,250
0,200
0,150
0,100
0,050
0,000
1953 1955 1957 1959 1961 1963 1965 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1980 1982 1984 1986 1988 1990 1992
YEAR
EAST U5MR 93
CHILEAN U5MR 93
EAST U5MR 78
CHILEAN U5MR 78

FIGURE 3.3.3. COMBINED INFANT AND UNDER-FIVE MORTALITY RATE ESTIMATIONS FOR BOTH SEXES



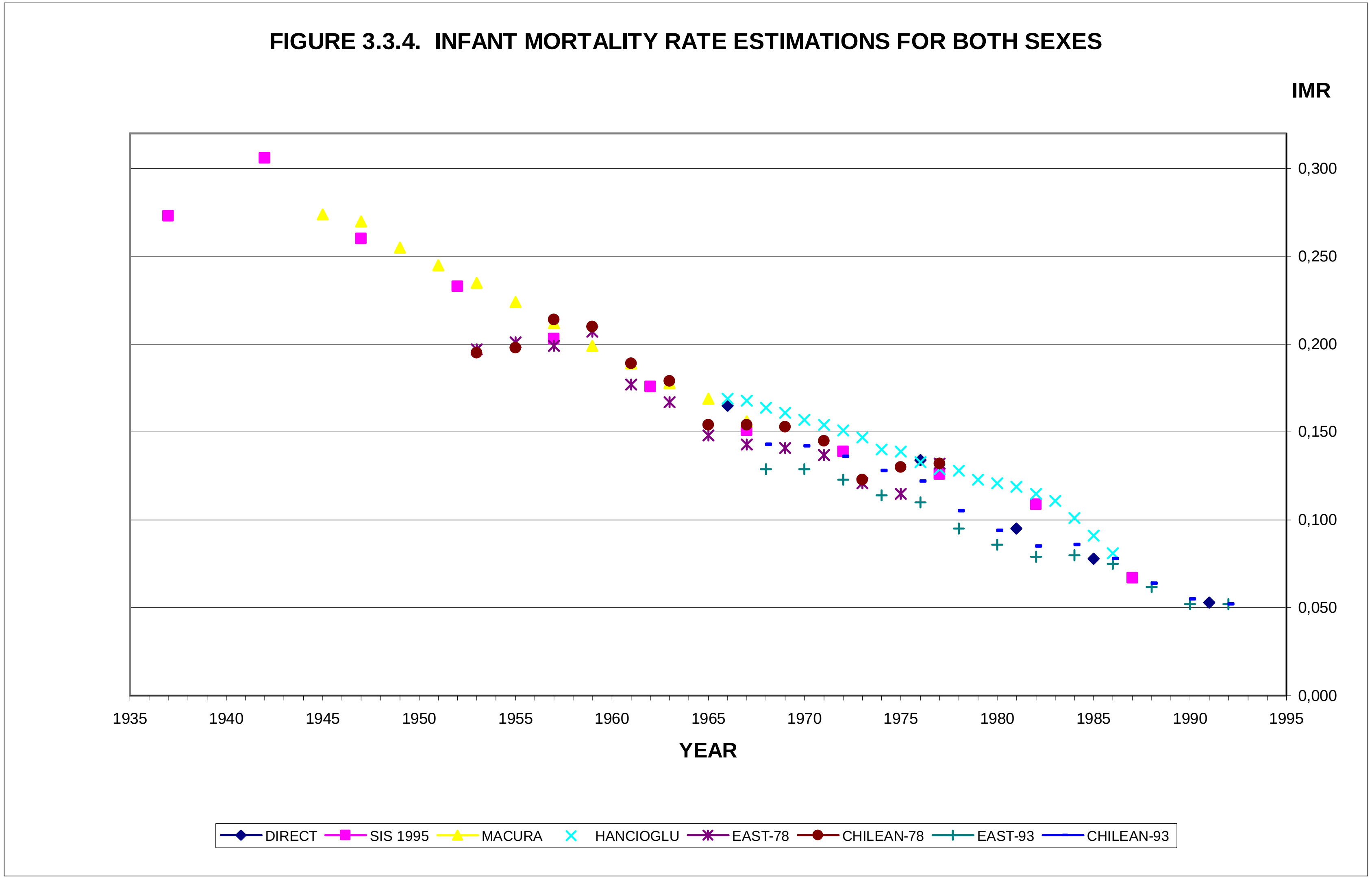
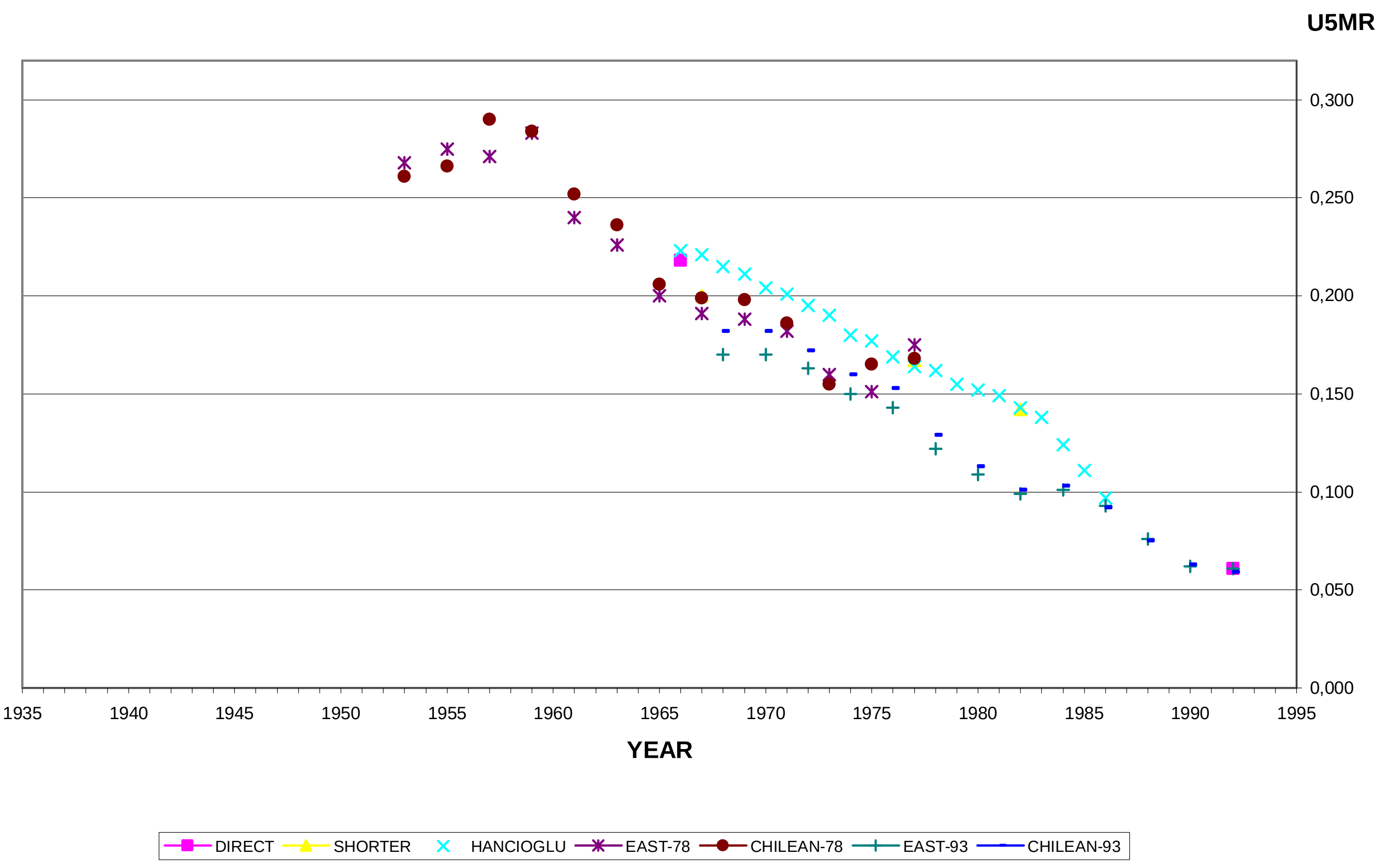
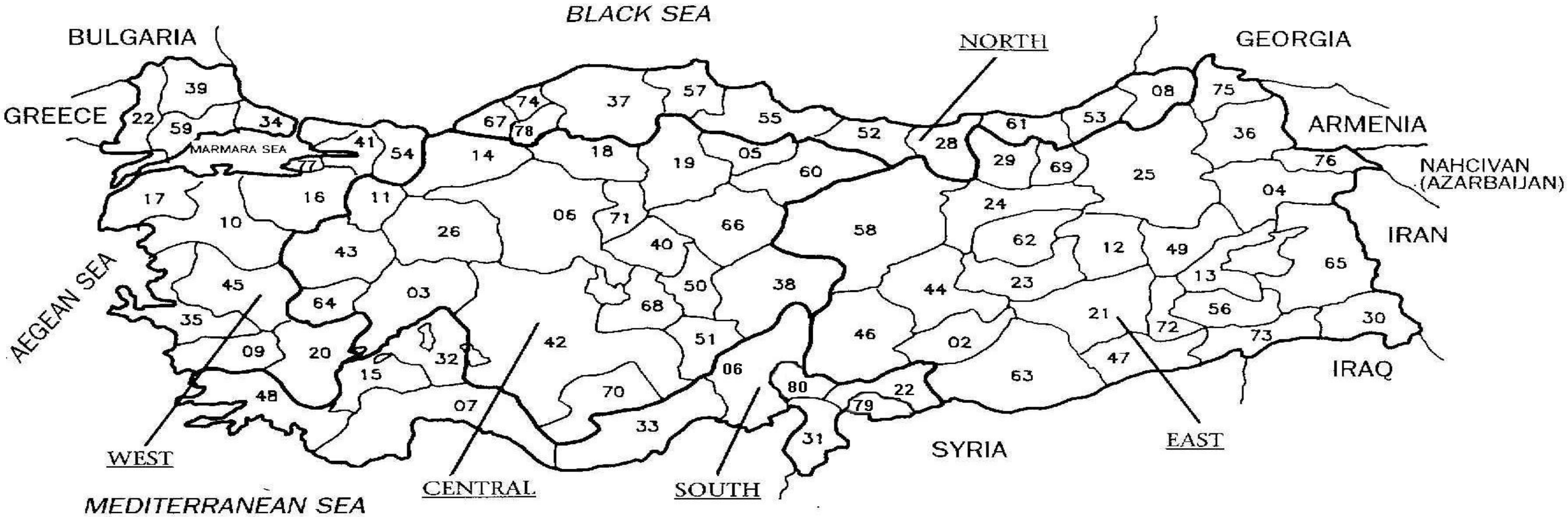


FIGURE 3.3.4. INFANT MORTALITY RATE ESTIMATIONS FOR BOTH SEXES
IMR
0,300
0,250
0,200
0,150
0,100
0,050
0,000
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
YEAR
DIRECT
SIS 1995
MACURA
HANCIOGLU
EAST-78
CHILEAN-78
EAST-93
CHILEAN-93

FIGURE 3.3.5. UNDER-FIVE MORTALITY RATE ESTIMATIONS FOR BOTH SEXES



# TURKEY




**REGIONS AND PROVINCES**

| WEST | SOUTH | CENTRAL | | NORTH | EAST | |
|---|---|---|---|---|---|---|
| 09 Aydın | 01 Adana | 03 Afyon | 60 Tokat | 08 Artvin | 02 Adıyaman | 49 Muş |
| 10 Balıkesir | 07 Antalya | 05 Amasya | 64 Uşak | 28 Giresun | 04 Ağrı | 56 Siirt |
| 16 Bursa | 15 Burdur | 06 Ankara | 66 Yozgat | 37 Kastamonu | 12 Bingöl | 58 Sivas |
| 17 Çanakkale | 27 Gaziantep | 11 Bilecik | 68 Aksaray | 52 Ordu | 13 Bitlis | 62 Tunceli |
| 20 Denizli | 31 Hatay | 14 Bolu | 70 Karaman | 53 Rize | 21 Diyarbakır | 63 Ş. Urfa |
| 22 Edirne | 32 Isparta | 18 Çankırı | 71 Kırıkkale | 55 Samsun | 23 Elazığ | 65 Van |
| 34 İstanbul | 33 İçel | 19 Çorum | | 57 Sinop | 24 Erzincan | 69 Bayburt |
| 35 İzmir | 48 Muğla | 26 Eskişehir | | 61 Trabzon | 25 Erzurum | 72 Batman |
| 39 Kırklareli | 79 Kilis | 38 Kayseri | | 67 Zonguldak | 29 Gümüşhane | 73 Şırnak |
| 41 Kocaeli | 80 Osmaniye | 40 Kırşehir | | 74 Bartın | 30 Hakkari | 75 Ardahan |
| 45 Manisa | | 42 Konya | | 78 Karabük | 36 Kars | 76 Iğdır |
| 54 Sakarya | | 43 Kütahya | | | 44 Malatya | |
| 59 Tekirdağ | | 50 Nevşehir | | | 46 K. Maraş | |
| 77 Yalova | | 51 Niğde | | | 47 Mardin | |