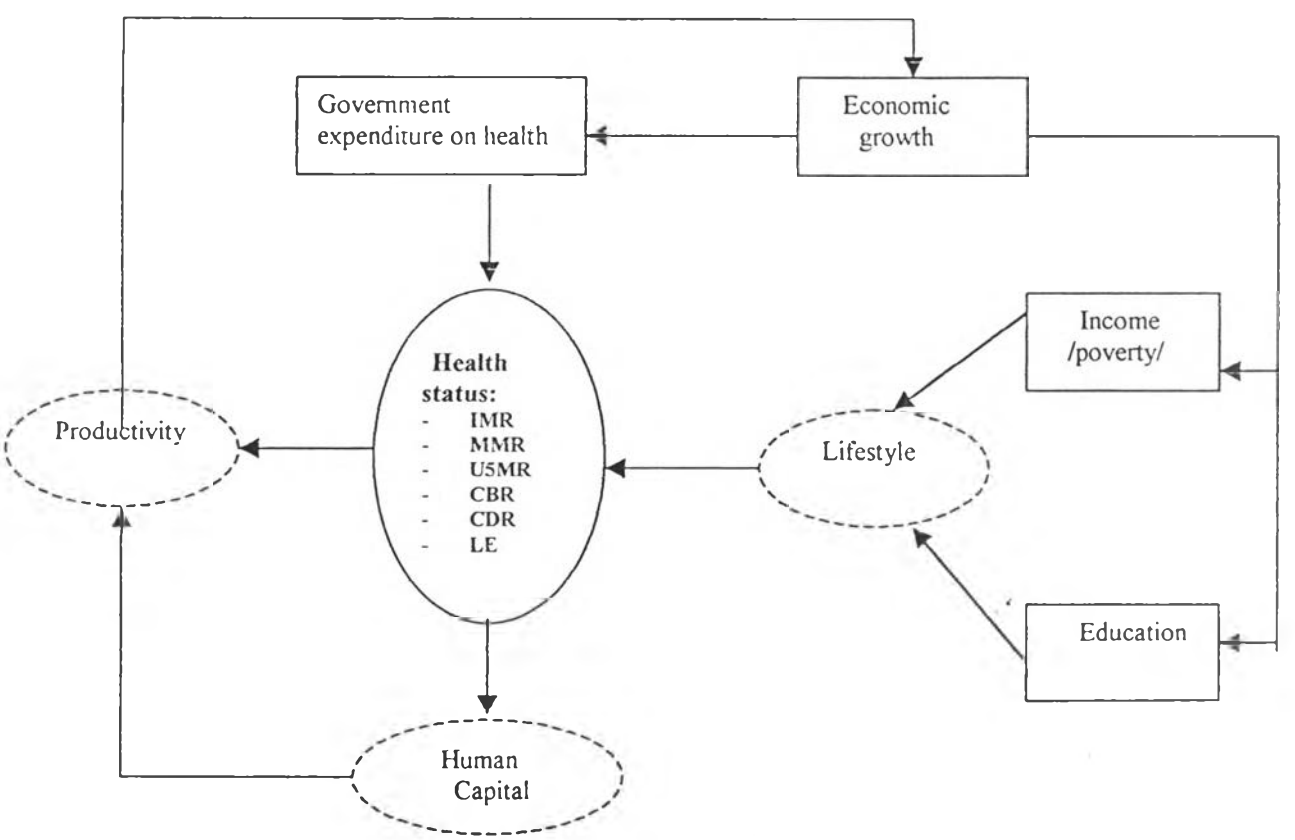
CHAPTER 4

EMPIRICAL ANALYSIS OF THE INTERACTION BETWEEN ECONOMIC INDICATORS AND HEALTH STATUS

4.1. Conceptual framework

The objective of this research is directed to determine interaction between economic indicators and health status at the provincial level. The conceptual framework shows the interrelationship between these factors based on the study findings which have done before. Figure 3.1 is a simple graphic presentation of the links between economic growth and health. In the rectangles with solid lines are independent variables which included in this study. In the circle with solid lines, are dependent variables or health indicators.

Figure 4.1. Conceptual framework



The conceptual framework is based on the almost universal agreement that the overall economic development has a greater role in providing basic conditions for improved living standard. Economic development results poverty reduction, improved educational level, improved nutrition and more resources for health. Better health, in turn contributes to enhanced human development and thus to economic growth. Therefore, it is obvious that economic recession leads to increase in unemployment and poverty and decline in basic education level which are main causes of deterioration in health. Worsened nutrition, increased illness, and redundant skills decrease labor productivity.

A number of study evidence show that income, poverty, nutrition, education and expenditure on health. are the main socio-economic factors that effect on the health status. On the basis of these study results we can say that the two factors have a major effect on the health status. The first is the personal lifestyle. From the above mentioned socio-economic factors, income and education bring changes in personal lifestyle. The second factor is the amount and effectiveness of government spending on health.

People's opportunities to achieve better education depend on their income or/and overall economic development. However, at the same income level, their health status is not same. Every person has the same access to the market bundle of goods and services available at the given income level. But choices from these goods and services are different. They select according to their lifestyle. Differences in choice and on the other hand differences in lifestyle can be explained by their level of education. Because, as education level increases, the level of information about the factors related to their choices increases. Otherwise, a more educated person is more likely to be aware of the relationship between between health and nutrition or physical exercise. Therefore, educated people tend to make choices that are better for their health. In this context, education is the crucial function of health status as it is a primary agent in the human lifestyle even when income, poverty, government expenditure taken together.

The economic downturn leads to decrease in basic education level, in turn it results in a decline health status. The health effect of a given total decline in income will depend on how the decline in income is distributed. Where poverty is high, there is greater reduction in health status. Most study results report that public health spending declines during the recession period. However, at any level of income, education and effectiveness, the reduced government spending on health should yield worsening in health, all else being equal. Because, first as the health budget decrease, government's ability to implement the activities which create positive externalities decreases. Second, as a result of reduced government expenditure, quality of health care often falls. Due to these reasons, reduced government expenditure on health leads to deterioration in health.

In this context, economic recession has a direct and indirect effect on health depending on the time period. Infant and child health indicators are more sensitive than adult health. However, health status may not show sudden worsening despite economic deterioration. Because, medical capital as well as safe water supplies and sanitation accumulated from the past incomes.

4.2. Variables

Table 4.1. summarizes the all variables which are used in this study with their definition and unit of measurement classifying into dependent and independent variables.

Table 4.1. Variables, their definitions and unit of measurement.

Name of Variables	Note	Definition of variables	Unit of measurement
Dependent variables:			
1. Infant mortality rate	IMR	The number of deaths in one year of infants less than 1 year old per 1000 babies born alive during the year.	Per 1,000 live births
2. Maternal mortality rate	MMR	The annual number of deaths of women from pregnancy- related causes per 100,000 live births.	Per 100,000 live births
3. Life expectancy	LIFE	The number of years new born infant would live if Prevailing patterns of mortality at the time of birth were to stay the same throughout the child's life.	Years
4. Underfive mortality rate	U5MR	The annual number of deaths of children under age five per thousand of live births.	Per 1,000 live births
5. Crude birth rate	CBR	Annual number of births per thousand population.	Per 1,000 population
6. Crude death rate	CDR	Annual number of deaths per thousand population.	Per 1,000 population

Independent variables: 1. Number of livestock	LS	Number of livestock per capita (proxy of GDP)	Number
2. Number 8 – years secondary school graduates	EDUC	Number of 8-years secondary school graduates as a percentage of total population	Percentage
3. Poverty incidence	POV	The proportion of population whose income is below the poverty line.	Percentage
4. Government expenditure for health	EXPEND	The expenditure at all levels of government spent for health and health care.	Per capita

4.3. Hypothesis about the effect of socio-economic variables on health status

The purpose of this subsection is to predict the influence of selected socio-economic indicators on health status. These variables or factors will be included in the model to estimate their effect on health status of the population at the province level.

4.3.1. Number of livestock (LS)

Per capita livestock head will be used as a proxy of GDP per capita at the province level. In Mongolia, the traditional economy is focused on livestock. Livestock production is as a share of GDP per capita is on average more than one-third. Also livestock become a main source of household income especially, in rural areas after privatization. Correlation coefficient between number of livestock and GDP is 0.35. Therefore, number of livestock per capita can be considered as a proxy of GDP per capita.

Generally, a strong link exists between economic growth and health. According to the authors that mentioned in the literature review (chapter 2) the economic development provide conditions to live with better health. Therefore, if livestock per capita can be good proxy of GDP per capita, it's decrease will lead to decline in all health indicators. However, this impact depends on time. Therefore, the expected sign associated with the

number of livestock per capita will be negative in the short run and positive in the long run for mortality rate (infant, underfive, maternal mortality and crude birth rate) regressions.
In the life expectancy regressions the expected sign of this variable is positive in the short run and negative in the long run.

But it is very difficult to predict the sign in the birth rate regression, because, this variable possibly be depends more on socio-demographic factors and disease pattern than income. However, a negative sign may be expected as a result of economic difficulties.

4.3.2. Government expenditure on health (EXPEND)

Government health expenditure is an exogenous variable, because it depends on the intersectoral allocation of economic resources between the private and public sectors. On the other hand, a country can make use of economic growth in different ways: enhancing public expenditure or increasing the private consumption or investing for ensuring further economic growth. According to the World development Report 1993, the amount of public health spending is very important to explain changes in health . It is obvious that higher health expenditure per capita should yield lower morbidity and mortality rates, all else being equal. Therefore, decreasing trend in government expenditure on health may lead to increase in morbidity, mortality rates and decrease in life expectancy. Thus, the coefficient associated with the public health expenditure is expected to be positive in the mortality regressions, negative in the life expectancy regression. However, coefficient sign in the crude birth rate regression is ambiguous. May be crude birth rate more related to the expenditure on family planning services than total government expenditure.

4.3.3. Poverty (POV)

The proportion of people by provinces whose income is under the poverty line will be used to investigate effect of poverty on health.

A number of authors (Myron J. Lefcowitz 1982, Chen 1993, Gunatilleke 1995) mentioned that poverty has a powerful influence on health. As the number of people under the poverty line decreases, the health status especially, maternal and child health, communicable disease rates decreases.

In case of Mongolia, despite increasing GDP per capita since 1994, poverty has been rising during the past years, and in 1996 was higher than in any year since 1991, with the exception of 1994. In other words, an increase in national income has not benefited the poor. Estimates of income distribution for 1996 indicate that the poorest half of the population has about one-third of total income. The Gini coefficient in 1996 was 0.318. As a result of this high inequality the proportion of poor people has been increasing.

Therefore, the increasing incidence rate of poverty might result increase in morbidity and mortality rates. Then the expected sign of coefficient associated with poverty might be positive. It is very difficult to say an increasing trend of poverty directly affects the health status in the short run. However, our purpose is to know how poverty variable is sensitive.

4.3.4. Education (EDUC)

There is a strong relationship between education and health (World Development Report: Investing in Health, 1993). Education has a great influence on adult health. Better education changes personal life style and gives opportunity to make choices that are better for their health. Also a number of studies suggest that the maternal education has an important role in child health particularly more strong relationship between maternal education and infant mortality rate and underfive mortality rate. A child's health is affected much more by the mother's schooling than by others' schooling.

In our study the number of eight- years secondary school graduates is chosen to represent education status of the population. Due to lack of data, it is calculated as a percentage of the total population. There are 2 levels of secondary education in Mongolia. The first level comprises grades 4-8, and graduates from the 8^{th} grade are considered as having general secondary education. It is investigated as a basic compulsory education by the Education Law. The main reason for choosing the percentage of eight-years secondary school graduates is that basic education has a significant effect on the overall education level and also reflects changes in education level during the transition period, because, decrease in completion rate of 8-years secondary school is higher than other level of education.

According to Ministry of Science and Education data, in Mongolia the number of children dropping out before completing secondary school increased from 6,133 in 1989, to a peak of 48,446 in 1992 before falling back to 14,272 in 1996. The total number of drop outs between 1989 and 1996 was 166,000. Therefore, the cumulative effect of this disruption will be to bring a wave of less-literature cohorts to pass through the age structure over the next 70 years.

However, it is difficult to predict the sign of coefficients associated with education; the decreasing trend of basic education level might have an influence on the health status negatively. It means that the expected sign associated with 8-years secondary education is positive in the infant mortality, underfive mortality, maternal mortality and crude death rate regressions, but negative in the life expectancy regressions.

Coefficient sign in crude birth rate regression is ambiguous. Educated women tend to have fewer children than less educated one because they can manage their number of births and can reduce their health risk from mistimed and unwanted pregnancies. Therefore, in the long run decrease in the number of secondary school graduates may result in an increase in birth rate.

4.4. Multiple regression model:

The multiple regression model is specified as below:

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta k Xk_i + \varepsilon_I \quad (4.1)$$

According to Pindyck and others (1991) the assumptions are:

1. The X's are nonstochastic. In addition, no exact linear relationship exists between two or more of the independent variables.
2. i. The error term has 0 expected value and constant variance for all observations.
   ii. Errors corresponding to different observations are independent and therefore uncorrelated.
   iii. The error variable is normally distributed.

As we know that the classical linear regression model assumes that regression model is linear in the parameters. If model is not linear in the parameters such as following exponential regression model:

$$Y_i = \beta_1 X_i^{\beta_2} * e^{u_i} \quad (4.2)$$

Which can be expressed alternatively as $\text{Ln } Y_I = \text{Ln } \beta_1 + \beta_2 \text{Ln} X_I + u_I$ (4.3)

Where Ln – natural log, if we write as

$$\text{Ln } Y_I = \alpha + \beta_2 \text{Ln} X_I + u_I \quad (4.4)$$

$\alpha = \text{Ln } \beta_1$, this model is linear in the parameters α and β_2, linear in the logarithms of the variables Y and X, and can be estimated by OLS regression. It is called a log-linear model.

The objective of this method of analysis here is to predict or estimate the value of the health status of the population, the dependent variable Y, corresponding to a given value of economic indicators such as GDP per capita, number of livestock per capita, public health expenditure per capita, household income, eight-years secondary school completion rate which are the independent variables Xi. Assumptions here is the linear relationship between the parameters of the health and socio-economic variables in the model as above mentioned. It can be specified by following equation:

$$\text{Log HS} = \text{Log(LS)}, \text{Log(POV)}, \text{Log(EDUC)}, \text{Log(EXPEND)} \quad (4.5)$$

Where:
HS – health status indicator
LS – number of livestock
POV – proportion of the people under poverty line
EDUC – number of secondary school graduates
EXPEND – government expenditure on health

In economics, a substantial period of time may pass between the economic decision making period and the final impact of a change in a policy variable. If the appropriate decision or response period is sufficiently long, lagged explanatory variables should be included in the model. The entire effect of the explanatory variable occurs in the time period. For instance, in our case the dependence of a health status variable on socio-economic variables does not occur at the same time period. Therefore, we should specify the model that can distribute health status changes over a time periods. It can be specified by using distributed lag models in our equation. Then the lagged explanatory variables will account for the time adjustment process. Also, we would include in the model one year lagged dependent variable in order to calculate long run elasticities.

Finally, our model can be specified as following:

$$Log(HS)_t = Log\,(HS)_{t-1}, Log(LS)_t, Log(LS)_{t-1}, Log(POV)_t, Log(POV)_{t-1}, Log(EDUC)_t, Log(EDUC)_{t-1}, Log(EXPEND)_t, Log(EXPEND)_{t-1} \quad (4.6)$$

Where:
HS – health status indicator
LS – livestock per capita
POV – proportion of the people under poverty line
EDUC – number of secondary school graduates
EXPEND – government expenditure on health

If write by each equation according to the health status variable:

$$LogLE = f(LogLE_{t-1}, LogLS, LogLS_{t-1}, LogPOV, LogPOV_{t-1}, LogEDUC, LogEDUC_{t-1}, LogEXPEND, LogEXPEND_{t-1}) \quad (4.7)$$

$$LogIMR = f(LogIMR_{t-1}, LogLS, LogLS_{t-1}, LogPOV, LogPOV_{t-1}, LogEDUC, LogEDUC_{t-1}, LogEXPEND, LogEXPEND_{t-1}) \quad (4.8)$$

$$LogU5MR = f(LogU5MR_{t-1}, LogLS, LogLS_{t-1}, LogPOV, LogPOV_{t-1}, LogEDUC, LogEDUC_{t-1}, LogEXPEND, LogEXPEND_{t-1}) \quad (4.9)$$

$$LogMMR = f\,(LogMMR_{t-1}, LogLS, LogLS_{t-1}, LogPOV, LogPOV_{t-1}, LogEDUC, LogEDUC_{t-1}, LogEXPEND, LogEXPEND_{t-1}) \quad (4.10)$$

$$LogCBR = f(LogCBR_{t-1}, LogLS, LogLS_{t-1}, LogPOV, LogPOV_{t-1}, LogEDUC, LogEDUC_{t-1}, LogEXPEND, LogEXPEND_{t-1})$$

(4.11)

$$LogCDR = f(LogCDR_{t-1}, LogLS, LogLS_{t-1}, LogPOV, LogPOV_{t-1}, LogEDUC, LogEDUC_{t-1}, LogEXPEND, LogEXPEND_{t-1})$$

(4.12)

$$LogLS = f(LogLS_{t-1}, LogLE, LogIMR, LogU5MR, LogMMR, LogCBR, LogCDR)$$

(4.13)

4.4.1. Measurement error

In the social sciences researcher often depend on secondary data. There are many reasons of measurement error such as of proxy variable, nonresponse errors, reporting errors, computing errors etc. Whatever the resaons, errors of measurement represent a potentially troublesome problem. For instance it can be shown in the following model.

$$Y^{*}_i = \beta^{*}_1 + \beta^{*}_2 X^{*}_i + \beta^{*}_3 X^{*2}_i + \beta^{*}_4 X^{*3}_i + u^{*}_i$$

Where $Y^{*}_i = Y_1 + \varepsilon_1$ and $X^{*}_i = X_1 + w_1$, ε_1 and w_1 being the errors of measurement. It is stated that instead of using the true Y_i and X_i we use their proxies, Y^{*}_i and $_2X^{*}_i$ which may contain errors of measurement. Errors of measurement can be occur either in the dependent variable or in the independent variables. If it is in the dependent variable it gives unbiased estimates of the parameters and their variances, the estimated variances are now larger than in the case where there are no such errors of measurement. If it exists in the independent variables there is a serious problem because this makes consistent estimation of the parameters impossible. In this case, one of the suggested solution is that the use of instrumental or proxy variables. But to find good proxy variables also not easy.

4.5. Data collection and data processing

4.5.1. Data collection

Two main secondary sources of data are used in this study: State Statistical Office and Ministry of Health and Social Welfare. However, non-availability of data is one of the limitations of this study. The following table shows the list of available data for this thesis.

Table 4.2. List of available data

Name of data	Available years	Level
1. Number of livestock head	1991-1996	Province
2. Eight-years secondary school completion rate	1980-1996	Province
3. Poverty	1991-1996	Province
4. Total population	1970-1996	Province
5. Health budget expenditure	1989-1996	Province
6. Crude birth rate	1989-1996	Province
7. Crude death rate	1989-1996	Province
8. Maternal mortality rate	1989-1996	Province
9. Infant mortality rate	1989-1996	Province
10. Underfive mortality rate	1991-1996	Province
11. Life expectancy	1991-1996	Province

4.5.2. Pooling of data.

The method of combining the data is often used when observations are available for several individual units (household, firms, provinces, cities, etc.) over a period of time (usually years). If data are available for each individual unit over a series of years, we might question whether cross-section parameters remain constant over time. If they do, we can consider the possibility of combining cross-section and time series data to obtain more efficient parameter estimates. This process of combining cross-section and time series data is called pooling. But shift of cross-section data over time and inclusion of time series related explanatory variables such as expectations, prices and interest rates in the model introduce a new dimension difficulty to the problem of model specification.
In our study, 6 years (from 1991 to 1996) time series data on socio-economic and health indicators such as number of livestock head, proportion of the people under poverty line, number of secondary school graduates, mortality rates at the province level are pooled.
The total number of observations is 132. (6 years * 22 provinces = 132)