CHAPTER 5

RESULTS

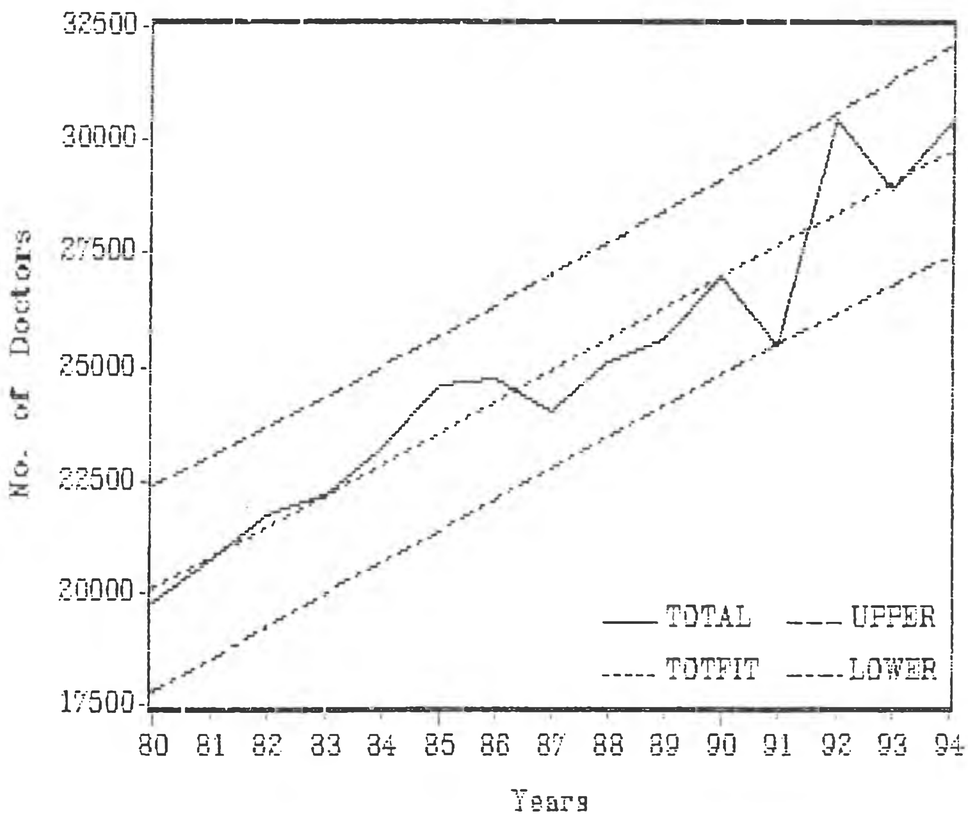
5.1 Estimated Supply for Health Manpower

5.1.1 Forecasting the number of doctors to be supplied to the health manpower stock for the next six years

1. Selecting the forecasting model

Various models were tried, the detailed results are shown in Table 5.1. Figure 5.1 depicts the Linear trend model

FIGURE 5.1: Forecast No. of Drs for HM (Linear trend model)



The most well-fitting model for the data is the linear trend model because all of the statistics tests were significant, while the statistical tests of the quadratic and cubic models were not significant. The Durbin-Watson statistics of quadratic and cubic models showed that there was autocorrelation. Therefore, those models do not pass the D-W test (see Table 5.1 and Appendix 3; 3.1; 3.2).

The estimated equations of the linear trend model (with t statistics in parentheses) is:

$$\widehat{NDR} = 19383.229 + 692.396t$$
$$(35.76) \quad (11.6)$$

adj R^2 = 0.91 $F_{(1/13)}$ = 134.96 DW = 2.54

where NDR is number of doctors forecasted for health manpower.

Table 5.1: Some statistical tests of the accuracy of the forecast models

Model / *Statistics*	*Linear trend*	*Quadratic*	*Cubic*
Dependent variable	Number of doctors/ pop.	Number of doctors/ pop.	Number of doctors/ pop.
Independent variable	Time	Time $Time^2$	Time $Time^2$ $Time^3$
α (t-statistic)	19383.2 (35.76)**	19780.1 (21.65)**	19324.8 (21.65)**
β_1 (t-statistic)	692.4 (11.6)**	552.3 (2.1)	1495.1 (2.14)
β_2 (t-statistic)		8.7 (0.5)	-133.9 (-1.3)
β_3 (t-statistic)			5.9 (1.4)
F-statistic	134.9**	64.0**	47.28**
Durbin-Watson statistic	2.54	2.6	3.06
R^2	0.91	0.91	0.92
Adjusted R^2	0.90	0.90	0.90

Note: * for 5 % of level of significance.
** for 1 % of level of significance.

Using the *Linear Trend Model*, the estimated numbers of doctors to be supplied to the health manpower stock for the next six years are shown in the table 5.2:

Table 5.2: Forecasted total number of doctors for the health sector for the next six years

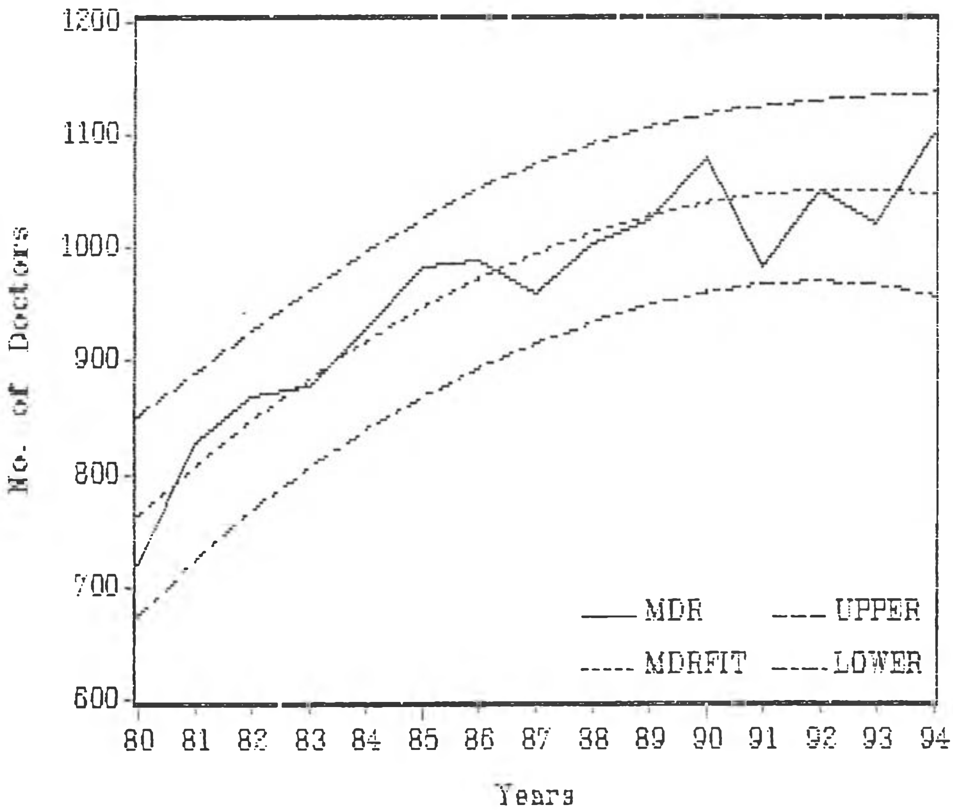
Years	*No. of doctors*
1995	30462
1996	31154
1997	31846
1998	32539
1999	33231
2000	33924

5.1.2 Forecasting the number of doctors to be supplied to the malaria control programme for the next six years

1. Selecting the forecasting model

Various models were tried, the detailed results are shown in Table 5.3. The following figure is the graph of the quadratic model.

FIGURE 5.2: Forecast No. of Drs for MCP (Quadratic model)



The most well-fitting model for the data is the quadratic model because all of the statistical tests were significant, while the statistical tests of the linear trend and cubic models were not significant. In Table 5.3, the Durbin-Watson statistics of linear trend and cubic models showed that there were autocorrelation in it. Therefore, those models do not pass the D-W test (see Table 5.3 and Appendix 4; 4.1; 4.2).

The estimated equations of the quadratic model (with t statistics in parentheses) is:

$$\widehat{NDR} = 715.03 + 49.76t - 1.83t^2$$

$$(22.56) \quad (5.4) \quad (-3.32)$$

adj R^2 = 0.89 $F_{(2/12)}$ = 51.3 DW = 2.24

Where NDR is number of doctors forecasted for the malaria control programme.

Table 5.3: Some statistic tests of the accuracy of the forecasting models

Model / *Statistics*	*Linear trend*	*Quadratic*	*Cubic*
Dependent variable	Number of doctors/ pop.	Number of doctors/ pop.	Number of doctors/ pop.
Independent variable	Time	Time $Time^2$	Time $Time^2$ $Time^3$
α (t-statistic)	798.39 (31.04)**	715.03 (22.56)**	648.43 (15.15)**
β_1 (t-statistic)	70.34 (7.19)**	49.76 (5.46)**	92.91 (4.14)**
β_2 (t-statistic)		8.7 (0.5)	-8.36 (-2.6)*
β_3 (t-statistic)		-1.83 (-3.3)*	0.27 (2.0)
F-statistic	51.70**	51.30**	44.91**
Durbin-Watson statistic	1.26	2.24	2.66
R^2	0.79	0.89	0.92
Adjusted R^2	0.78	0.87	0.90

Note: * for 5 % of level of significance.
** for 1 % of level of significance.

Using the equation from the *Quadratic Model*, the estimated number of doctors to be supplied to the malaria control programme for the next six years are shown in Table 5.4:

Table 5.4: Forecasted number of doctors for malaria control programme for the next 6 years

Years	*No. of doctors for MCP.*
1995	1041
1996	1030
1997	1015
1998	997
1999	975
2000	950

The table shows that the number of doctors forecasted for the malaria control programme are declining as the years progress. This situation will be discussed in the next part (see part 5.1.5: comparison of number of doctors required and forecasted).

5.1.3 Forecasted population for the next six years

The population of the country in 1994 is 72.5 million, the growth rate of population is 2%, so the population in the next six years can be shown in the following table (Table 5.5)

Table 5.5: Forecasted population for the next six years

Years	*Population (million)*
1995	73.95
1996	75.429
1997	76.93758
1998	78.47574
1999	80.0445
2000	81.64488

5.1.4 Number of required doctors based on population and policy

The policy of the government is to supply 4 doctors per 10,000 population for health manpower and 0.15 doctors per 10,000 population for malaria control programme. Based on these criteria, the number of doctors for overall health manpower and for the malaria control programme for the next six years will be as shown in Table 5.6):

Table 5.6: Number of doctors required for health manpower and malaria control programme for the next six years

Years	*Population*	*No. of Drs req. for HM*	*No. of Drs req. for MCP*
1995	73.95	29580	1109
1996	75.429	30172	1131
1997	76.93758	30776	1154
1998	78.47574	31392	1177
1999	80.0445	32020	1201
2000	81.64488	32660	1225

From the above results, a comparison is made to see the difference between number of doctors forecasted and number of doctors required for health manpower and malaria control programme for the next six years.

5.1.5 Comparison of number of doctors required and forecasted

Table 5.7: Comparison of the number of doctors required and forecasted

Years	*No. of Drs required for HM*	*No. of Drs forecasted for HM*	*Difference between forecasting & requirement*	*No. of Drs required for MCP*	*No. of Drs forecasted for MCP*	*Difference between forecasting & requirement*
1995	29580	30462	+ 882	1109	1041	- 68
1996	30172	31154	+ 982	1131	1030	- 101
1997	30776	31846	+ 1070	1154	1015	- 139
1998	31392	32539	+ 1147	1177	997	- 180
1999	32020	33231	+ 1211	1201	975	- 226
2000	32660	33924	+ 1264	1225	950	- 275

From the table we can see that in the next six years, there is a discrepancy between the trend of number of doctors supplied for health manpower and number of doctors for the malaria control programme. Number of doctors supplied for health manpower will be in excess of needs and number of doctors for malaria control programme will be short of the needed requirement. The reason for the decline in the number of doctors in malaria control programme is that the programme is carried out in the rural and mountainous areas. In those areas, the living and working conditions are poor and difficult. New graduated medical doctors do not want to go to work for the programme, even people who are working for malaria control programme do not want to continue to work for the programme. They want to move to work for other programmes. That is why the number of doctors forecasted for the malaria control programme declines as the years progress. Meanwhile on the other side, the number of doctors supplied for health manpower will be in excess of needs (as was mentioned in the literature review, part 2.2, chapter 2).

This situation can be explained that because in recent years, the socio-economics of the country have changed, this affects the educational sector. There are many ways to enter the universities such as the open system, in-service training, short term, part time etc. The number of students entering the university or college increased to four or five times more than before. It is good in terms of increasing the number of university graduates per population but in the other side, it is not good because the development of the country requires a stable proportion between university graduates, technicians, high technical workers etc. One other thing is that the general level of education of the population is still low, there are five secondary school pupils per 100,000 population in the cities. So if the number of the students entering the university increases, it will lead to a reduction of the number of students entering the technical school or secondary professional school, and it is not good for the development of the country (Vo Khanh Tuyen, 1995).

Health manpower is in the same situation. The number of doctors per population exceed the criteria of the government but the number of assistant medical doctors, nurses, othe health personnel is still lower the number of requirement. The other reason is the income of the health personnel, special nurses is low, so many of them want to become doctors (after working for public health for five years and passing the entry examination of the medical college). In recent years, the government has a policy that doctors can open private clinics to provide health care services, so that it is easier for doctors to have extra work and earn money. That is why the number of doctors is rapidly increased while the number of nurses, other health personnel are under the level of need.

As the statement of the limitation of the study said that there is no actual empirical data calculation but only hypothetical calculation and analysis. The result of forecasting raises the point that there are trends of shortage of qualified health manpower for the malaria control programme and a surplus of qualified health manpower for overall health manpower. Also, there is a need to reallocate the distribution of health manpower, and the government should have a policy to remedy this situation.

Because of lack of data, the study did not estimate the total supply of assistant medical doctors for the health sector and malaria control programme. In the future , some further studies can be caried out with the instrument in this study to forecast any kinds of health manpower or any health programe.

5.1.6 Sensitivity analysis

The population forecasted for the next 6 years is based on the average growth rate of 2 %. If the growth rate of the population is higer or lower by 10 % of the average growth rate, the total number of doctors required for the health sector and malaria control programme will change, the following tables show how sensitive it is.

Table 5.8: Number of doctors required for health manpower (if the population change)

Years	*POP. (lower: 1.8 %)*	*No. of Drs*	*% Change*	*POP. (higher: 2.2 %)*	*No. of Drs*	*% Change*
1995	73.805	29522	0.19	74.095	29638	0.19
1996	74.4135	29765	1.3	75.729	30290	0.39
1997	75.7529	30301	1.5	77.3909	30956	0.58
1998	77.1164	30846	1.7	9.0935	31637	0.78
1999	78.5045	31402	1.9	80.8338	32333	0.97
2000	79.9176	31607	2.09	82.6119	33044	1.17

Table 5.9: Number of doctors required for the malaria control programme (if the population change)

Years	*POP. (lower: 1.8 %)*	*No. of Drs*	*% Change*	*POP. (higher: 2.2 %)*	*No. of Drs*	*% Change*
1995	73.805	1107	0.18	74.095	1111	0.18
1996	74.4135	1116	1.32	75.729	1136	0.44
1997	75.7529	1136	1.5	77.3909	1161	0.52
1998	77.1164	1157	1.69	79.0935	1186	0.76
1999	78.5045	1178	1.9	80.8338	1213	0.99
2000	79.9176	1199	2.1	82.6119	1239	1.14

From the two above tables, we can see that with in 10% error of total the growth rate of the population, the percentage of number of doctors for the health sector and malaria control programme changed from 0.2 % to 2.1 % from the year 1995 to the year 2000. It is not much, and we can conclude that there is no sensitivity in number of doctors required when there is 10 % error in the growth rate of population.

5.2 Regression Analysis

To analyze the relationship between the allocation of health manpower and the effectiveness of the malaria control programme, the following multiple regression function is used:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Where :

Y = indicator of effectiveness of malaria control programme (as mortality rate)

X_1 = doctors/ population ratio.

X_2 = assistant medical doctors/ population ratio.

X_3 = nurses/ population ratio.

When using the multiple regression equation, the results of the regression analysis is near singular linear. That means we can not analyze the regresion between mortality rate and the three independent variables together. Therefore, each of the independent variables will be analyzed by simple linear regression.

5.2.1 Regression analysis between the doctors/ population ratio and the effectiveness of malaria control programme

1) The doctors/ population ratio and mortality rate

Using a linear regression function (where MOR = mortality rate and NDP = number of doctors per population) to analyze the data of the number of doctors per population and mortality rate of the 40 districts from 1985 to 1994 (see appendix 5). The fitted regression line is listed below. We have included the t statistics in parentheses below the estimated coefficients. We have placed a hat above the dependent variable as a reminder that the equation is used to calculate estimated values of the dependent variable.

$$\widehat{MOR} = 0.996 - 2.866NDP$$
$$(34.75) \quad (-24.3)$$
$$\text{adj } R^2 = 0.59 \qquad F_{(1/398)} = 590.59$$

The positive constant (representing the intercept term) implies that hypothetically, if there were no doctor in a given year, mortality would still occur. The coefficient of the number of doctors per population variable can be interpreted to mean that a one unit increase in doctors/ population ratio will lead to 2.866 units decrease in mortality rate. Notice that the slope coefficient is usually interpreted to measure the change in the dependent variable associated with a small change in the independent variable. The estimated coefficient is not unit-free. Its value is directly related to the units of measurement of the dependent variable mortality and the independent variable doctors/ population ratio. In this regression, we have chosen to write the t statistics, rather than the estimated standard errors, in parentheses. Using the t statistics we can reject the null hypothesis that the intercept and the slope are 0 at the 5 percent level of significance. The R^2 of 0.59 implies that the regression equation explain 59 percent of the variation in the dependent variable. The F value of 590.59 allows one to reject the null hypothesis that there is no relationship between number of doctors per population and mortality.

2) The doctors/ population ratio and morbidity rate

Using a linear regression function (where MBD = morbidity rate and NDP = number of doctors per population) to analyze the data of the number of doctors per population and mortality rate of the 40 districts from 1985 to 1994 (see Appendix 5). The fitted regression line is:

$$\widehat{MBD} = 1333.46 - 4049.08NDP$$
$$(37.76) \qquad (-27.86)$$
$$\text{adj } R^2 = 0.66 \qquad F_{(1/398)} = 776.53$$

The positive constant (representing the intercept term) implies that hypothetically if there were no doctor in a given year, morbidity would still occur. The coefficient of the number of doctors per population variable can be interpreted to mean that a one unit increase in doctors/ population ratio will lead to 4049.08 units decrease in morbidity rate. Notice that the slope coefficient is usually interpreted to measure the change in the dependent variable associated with a small change in the independent variable. The estimated coefficient is not unit-free. Its value is directly related to the units of measurement of the dependent variable morbidity and the independent variable doctors/ population ratio. In this regression, we have chosen to write the t statistics, rather than the estimated standard errors, in parentheses. Using the t statistics we can reject the null hypothesis that the intercept and the slope are 0 at the 5 percent level of significance. The R^2 of 0.66 implies that the regression equation explain 66 percent of the variation in the dependent variable. The F value of 776.53 allows one to reject the null hypothesis that there is no relationship between number of doctors per population and morbidity.

3) The doctors/ population ratio and number of population protected

Using a linear regression function (where NPP = number of population protected and NDP = number of doctors per population) to analyze the data of the number of doctors per population and number of population protected of the 40 districts from 1985 to 1994 (see appendix 5).

The fitted regression line is as follows:

$$\widehat{NPP} = -323.73 + 3999.74NDP$$
$$(-9.09) \quad (27.305)$$
$$R^2 = 0.65 \quad F_{(1/398)} = 745.59$$

The negative constant (representing the intercept term) implies that hypothetically if there were no doctor in a given year, number of population protected would not exist. The coefficient of the number of doctors per population variable can be interpreted to mean that a one unit increase in doctors/ population ratio will lead to 3999.74 units increase in number of population protected. Notice that the slope coefficient is usually interpreted to measure the change in the dependent variable associated with a small change in the independent variable. The estimated coefficient is not unit-free. Its value is directly related to the units of measurement of the dependent variable number of population protected and the independent variable doctors/ population ratio. In this regression, we have chosen to write the t statistics, rather than the estimated standard errors, in parentheses. Using the t statistics we can reject the null hypothesis that the intercept and the slope are 0 at the 5 percent level of significance. The R^2 of 0.65 implies that the regression equation explain 65 percent of the variation in the dependent variable. The F value of 745.59 allows one to reject the null hypothesis that there is no relationship between number of doctors per population and number of population protected.

4) The doctors/ population ratio and number of patients' visits

Using a linear regression function (where NPV = number of patients' visits and NDP = number of doctors per population) to analyze the data of the number of doctors per population and number of patients' visits (see appendix 5). The fitted regression line is listed below:

$$\widehat{NPV} = 1066.77 - 3239.26NDP$$
$$(37.76) \quad (-27.86)$$
$$R^2 = 0.66 \quad F_{(1/398)} = 776.53$$

The positive constant (representing the intercept term) implies that hypothetically if there were no doctor in a given year, the number of patients' visits would still occur. The coefficient of the number of doctors per population variable can be interpreted to mean that a one unit increase in doctors/ population ratio will lead to 3239.26 units decrease in number of patients' visits. Notice that the slope coefficient is usually interpreted to measure the change in the dependent variable associated with a small change in the independent variable. The estimated coefficient is not unit-free. Its value is directly related to the units of measurement of the dependent variable number of patients' visits and the independent variable doctors/ population ratio. In this regression, we have chosen to write the t statistics, rather than the estimated standard errors, in parentheses. Using the t statistics we can reject the null hypothesis that the intercept and the slope are 0 at the 5 percent level of significance. The R^2 of 0.66 implies that the regression equation explain 66 percent of the variation in the dependent variable. The F value of 776.53 allows one to reject the null hypothesis that there is no relationship between number of doctors per population and number of patients' visits.

Table 5.10: Summary table of regression analysis between doctors/ population ratio and effectiveness of malaria control programme

Effectiveness of MCP / *Regression with Drs/ pop. ratio*	*Mortality*	*Morbidity*	*No. of pop. protected*	*No. of patients' visits*
α (t-statistic)	0.996 (34.75)**	1333.4 (37.36)**	-323.7 (-9.09)**	1066.7 (37.76)**
β (t-statistic)	-2.866 (-24.3)**	-4049.0 (-27.8)**	3999.7 (27.3)**	-3239.2 (-27.8)**
F-statistic	590.6**	776.5**	745.5**	776.5**
R^2	0.59	0.66	0.65	0.66
adj R^2	0.59	0.66	0.65	0.66

Note: * for 5 % level of significance.
** for 1 % level of significance.

From the equations of the regression analysis, the following table shows the effects of the distribution of health manpower on the effectiveness of the malaria control programme

Table 5.11: Some examples of the effects of the doctors/ population ratio on the effectiveness of malaria control programme

Drs/ pop. ratio	*Mortality rate*	*Morbidity rate*	*Pop. protected*	*No. of Pts visits*
0.20	0.422	523.6	476.2	418.8
0.24	0.308	316.6	636.2	289.3
0.30	0.136	118.7	876.2	94.9

5.2.2 Regression analysis between the assistant medical doctors/ population ratio and the effectiveness of malaria control programme

1) The assistant medical doctors/ population ratio and mortality rate

Using a linear regression function (where MOR = mortality rate and NADP = number of assistant medical doctors per population) to analyze the data of the number of assistant medical doctors per population and mortality rate (see appendix 6). The fitted regression line is listed below:

$$\widehat{MOR} = 0.996 - 1.822NADP$$
$$(34.41) \quad (-24.7)$$
$$adj\ R^2 = 0.60 \quad F_{(1/398)} = 610.26$$

The positive constant (representing the intercept term) implies that hypothetically if there were no assistant medical doctor in a given year, mortality would still occur. The coefficient of the number of assistant medical doctors per population variable can be interpreted to mean that a one unit increase in assistant medical doctors/ population ratio will lead to 1.822 units decrease in mortality rate. Notice that the slope coefficient is usually interpreted to measure the change in the dependent variable associated with a small change in the independent variable. The estimated coefficient is not unit-free. Its value is directly related to the units of measurement of the dependent variable mortality and the independent variable assistant medical doctors/ population ratio. In this regression, we have chosen to write the t statistics, rather than the estimated standard errors, in parentheses. Using the t statistics we can reject the null hypothesis that the intercept and the slope are 0 at the 5 percent level of significance. The R^2 of 0.60 implies that the regression equation explain 60 percent of the variation in the dependent variable. The F value of 610.26 allows one to reject the null hypothesis that there is no relationship between number of assistant medical doctors per population and mortality.

2) The assistant medical doctors/ population ratio and morbidity rate

Using a linear regression function (where MBD = morbidity rate and NADP = number of assistant medical doctors per population) to analyze the data of the number of assistant medical doctors per population and mortality rate (see Appendix 6). The fitted regression line is:

$$\widehat{MBD} = 1334.44 - 2583.44NADP$$
$$(37.84) \qquad (-27.93)$$
$$\text{adj } R^2 = 0.60 \qquad F_{(1/398)} = 780.24$$

The positive constant (representing the intercept term) implies that hypothetically if there were no assistant medical doctor in a given year, morbidity would still occur. The coefficient of the number of doctors per population variable can be interpreted to mean that a one unit increase in assistant medical doctors/ population ratio will lead to 2583.44 units decrease in morbidity rate. Notice that the slope coefficient is usually interpreted to measure the change in the dependent variable associated with a small change in the independent variable. The estimated coefficient is not unit-free. Its value is directly related to the units of measurement of the dependent variable morbidity and the independent variable assistant medical doctors/ population ratio. In this regression, we have chosen to write the t statistics, rather than the estimated standard errors, in parentheses. Using the t statistics we can reject the null hypothesis that the intercept and the slope are 0 at the 5 percent level of significance. The R^2 of 0.60 implies that the regression equation explain 60 percent of the variation in the dependent variable. The F value of 780.24 allows one to reject the null hypothesis that there is no relationship between number of assistant medical doctors per population and morbidity.

3) The assistant medical doctors/ population ratio and number of population protected

Using a linear regression function (where NPP = number of population protected and NADP = number of assistant medical doctors per population) to analyze the data of the number of assistant medical doctors per population and number of population protected (see Appendix 6). The fitted regression line is as follows:

$$\widehat{NPP} = -325.13 + 2553.24NADP$$
$$(-9.15) \qquad (27.40)$$
$$\text{adj } R^2 = 0.65 \qquad F_{(1/398)} = 751.23$$

The negative constant (representing the intercept term) implies that hypothetically if there were no assistant medical doctor in a given year, a number of population protected would not exist. The coefficient of the number of assistant medical doctors per population variable can be interpreted to mean that a one unit increase in assistant medical doctors/ population ratio will lead to 2553.24 units increase in number of population protected. Notice that the slope coefficient is usually interpreted to measure the change in the dependent variable associated with a small change in the independent variable. The estimated coefficient is not unit-free. Its value is directly related to the units of measurement of the dependent variable number of population protected and the independent variable assistant medical doctors/ population ratio. In this regression, we have chosen to write the t statistics, rather than the estimated standard errors, in parentheses. Using the t statistics we can reject the null hypothesis that the intercept and the slope are 0 at the 5 percent level of significance. The R^2 of 0.65 implies that the regression equation explain 65 percent of the variation in the dependent variable. The F value of 751.23 allows one to reject the null hypothesis that there is no relationship between number of assistant medical doctors per population and number of population protected.

4) The assistant medical doctors/ population ratio and number of patients' visits

Using a linear regression function (where NPV = number of patients' visits and NADP = number of assistant medical doctors per population) to analyze the data of the number of assistant medical doctors per population and number of patients' visits (see Appendix 6). The fitted regression line is:

$$\widehat{NPV} = 1067.52 - 2066.75NADP$$
$$(37.84) \qquad (-27.93)$$
$$\text{adj } R^2 = 0.66 \qquad F_{(1/398)} = 780.24$$

The positive constant (representing the intercept term) implies that hypothetically if there were no assistant medical doctor in a given year, number of patients' visits would still occur. The coefficient of the number of assistant medical doctors per population variable can be interpreted to mean that a one unit increase in assistant medical doctors/ population ratio will lead to 2066.75 units decrease in number of patients visits. Notice that the slope coefficient is usually interpreted to measure the change in the dependent variable associated with a small change in the independent variable. The estimated coefficient is not unit-free. Its value is directly related to the units of measurement of the dependent variable number of patients' visits and the independent variable assistant medical doctors/ population ratio. In this regression, we have chosen to write the t statistics, rather than the estimated standard errors, in parentheses. Using the t statistics we can reject the null hypothesis that the intercept and the slope are 0 at the 5 percent level of significance. The R^2 of 0.66 implies that the regression equation explain 66 percent of the variation in the dependent variable. The F value of 780.24 allows one to reject the null hypothesis that there is no relationship between number of assistant medical doctors per population and number of patients' visits.

Table 5.12: Summary table of regression analysis between assistant medical doctors/ population ratio and effectiveness of malaria control programme

Effectiveness of MCP / *Regression with Amdrs/ pop. ratio*	*Mortality*	*Morbidity*	*No. of pop. protected*	*No. of patients' visits*
α (t-statistic)	0.996 (35.41)**	1334.4 (35.26)**	-325.1 (-9.15)**	1067.5 (37.84)**
β (t-statistic)	-1.822 (-24.7)**	-2583.4 (-27.9)**	2553.2 (27.4)**	-2066.7 (-27.9)**
F-statistic	610.2**	780.2**	751.2**	780.2**
R^2	0.60	0.66	0.65	0.66
adj R^2	0.60	0.66	0.65	0.66

Note: * for 5 % of significance.
** for 1 % of significance.

From the equations of the regression analysis, the following table shows the effects of the distribution of health manpower on the effectiveness of malaria control programme.

Table 5.13: Some examples of the effects of the assistant medical doctors/ population ratio on the effectiveness of malaria control programme

AMDrs/ pop. ratio	*Mortality rate*	*Morbidity rate*	*Pop. protected*	*No. of Pts' visits*
0.30	0.45	559.4	440.8	447.5
0.35	0.36	430.2	568.5	344.2
0.40	0.27	301.1	696.2	240.8

5.3 Cost Analysis of Supplying Doctors and Assistant Medical Doctors (Substitute for Doctors)

5.3.1 Cost for supplying doctors (provider aspect)

The total cost of training doctors can be calculated as follows

i) Capital cost:
+ School building
+ Staff building
+ Student domitory
+ Vehicle
+ Equipment
+ Supplies (initial stocks)
+ Staff (initial)

ii) Recurrent cost:
+ Operating cost (Staff emoluments, supplies, utilities, vehicle operating cost, staff retraining, supervision, maintenance and repair of building and equipment...)
+ Capital replacement cost (building, equipment, vehicle...)

After caculating the total cost, the average cost of training one doctor can be obtained by dividing the total cost by the number of doctors to be trained each year.

The average cost of training a doctor for 6 years is approximately 10,000,000.00 Vietnam dong.

The average salary for a doctor per month is 600,000.00 Vietnam dong.

5.3.2 Cost for supplying assistant medical doctors (provider aspect)

The average cost of training one assistant medical doctor can be calculated as above and it is about 6,000,000.00 Vietnam dong.

The average salary for one assistant medical doctor per month is 400,000.00 Vietnam dong.

5.3.3 Cost saved from a substitution of assistant medical doctors for doctors

From the cost of training and the salary for supplying one doctor and one assistant medical doctor, it is clear that if the government cannot supply a number of doctors for the malaria control programme sufficient, the local authorities have to supply assistant medical doctors instead of doctors. By supplying one assistant medical doctor in place of one medical doctor, they can save 4,000,000.00 Vietnam dong for training and 200,000 VietNam dong for monthly salary (2,400,000.00 Vietnam dong per year).

From the result of the supply forcasting, we can see that in the next six years, there will be a shortage of the number of doctors supplied for the malaria control programme, so if the government still has not had any policy for manpower reallocation, with the malaria control programme, the local governments will have to continue to provide assistant medical doctors to malaria control programme offices. If the number of doctors required for the malaria control programme can be substituted by assistant medical doctors, cost saving for the malaria control programme is calculated and shown in Table 5.14.

However, the regression analysis also shows that the doctor/ population ratio is more strongly related to the effectiveness of the malaria control programme than the assistant medical doctor/ population ratio. It can be understood because the task of assistant medical doctors is different from that of medical doctors. To become assistant medical doctors, they are trained for three years while doctors are trained for six years. Assistant medical doctors are not allowed to do some tasks of the doctors which is in high technical medical care or in tertiary care because they were not trained to do it. That is why assistant medical doctors are less efficient than doctors, and assistant medical doctors can not totally substitute for doctors. There should be some models to distribute health manpower when assistant medical doctors are substitute for doctors such as placing groups assistant medical doctors under the supervison of the doctors in the area (districts or communes); and planning a certain period of retraining for asistant medical doctors etc.

Table 5.14: Cost saved from a subtitution of assistant medical doctors for doctors.

Years	*No. of Drs required for MCP*	*No. of Drs forecasted for MCP*	*No. of Amdrs needs to be substituted*	*Training cost saving for MCP (Million)*	*Salary saving (Million) for the MCP*
1995	1109	1041	68	272	163.2
1996	1131	1030	101	404	242.4
1997	1154	1015	139	556	333.6
1998	1177	997	180	720	432
1999	1201	975	226	904	542.4
2000	1225	950	275	1100	660

The money saved from the supply of assistant medical doctors for medical doctors might be used as a financial incentive for reallocation of manpower, retraining asistant medical doctors or buying more drugs, equipment, chemicals for vector control to improve the effectiveness of the malaria control programme.

5.4 Discussion and Policy Options

5.4.1 Discussion

As the result of the study, it is evident that the distribution or allocation of health manpower affects the effectiveness of the malaria control programme. The relationship between the allocation of health manpower and the effectiveness of malaria control programme is:

- If the number of doctors or assistant medical doctors increases, the mortality rate decreases.

- If the number of doctors or assistant medical doctors increases, morbidity rate decreases.

- If the number of doctors or assistants medical doctors increases, the number of population protected increases.

- If the number of doctors or assistant medical doctors increases, the number of patients' visits decreases.

In Table 5.8 (chapter 5), we have seen that there may be a shortage supply of doctors for the malaria control programme for the next six years, while the supply of number of doctors for total health manpower may be in surplus. The government should institute some reallocation of health manpower policies so that the problems of shortage in one area and surplus of health manpower in the other area for total health manpower and the malaria control programme can be solved.

The purpose of this study is also to provide some policy options (incentive policy) to the decision maker for better health manpower management (reallocation of health manpower).

5.4.2 Providing some policy options (incentive policy)

1) Incentive policy for producing health manpower (doctors)

a) For local applicants

- For the poor and rural areas in the country, more fellowships for medical school should be available for local students; so as to provide more opportunities for local applicants to become medical doctors so that it can be easier for students to become medical doctors and after graduated from medical school to work in their region.

- For those applicants, the criteria for entering medical school should be flexible than others to make it easier for local applicants to enter the medical school.

- For all the local applicants, who can enter medical school with those convenient conditions, a contract of agreement (which says that after graduating from medical school, they will have to work for public health facilities at the local area at least for a certain period of time) should be signed between the two parties (Government and applicants to medical schools) before the applicants enter the medical school; and in case of breaching the contract by the potential medical doctors, the latter will have to pay back a certain amount of money more than their fellowship and other costs required for their training to the Government which were provided to them for their training.

b) For transferable applicants

Before entering medical school, the applicants in general must accept the obligation to serve their patients in specified difficult areas as a condition to graduate from medical school or serving in those areas at the their graduation for at least a certain period of time. The Government would provide them with convenient conditions. A contract of agreement should be signed between the two parties (Government and applicants to medical schools) before the applicants enter the medical school; and in case of the breaching the contract by the potential medical doctors, the latter will have to pay back a certain amount of money more than their fellowship and other costs required for their training to the Government which were provided to them for their training.

2) Incentive policy options for the reallocation of health manpower (doctors)

a) For local officers

For local officers, some indirect financial management policies should be used such as giving additional or top-up allowance to salary and other additional benefit to officers posted in difficult areas. This policy should be also applied to the transfered officers.

b) For officers in promotion

- In promotion of the officers, some direct human resource management policies should be used such as promotion through experience gained from being posted in difficult areas.

- For local officers and officers in promotion, the combination of financial and non-financial benefits should be applied.