«Macroeconomics,
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Number 18

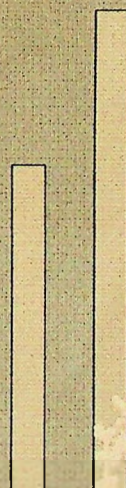# Exploring the health impact of economic growth, poverty reduction and public health expenditure

Technical Paper

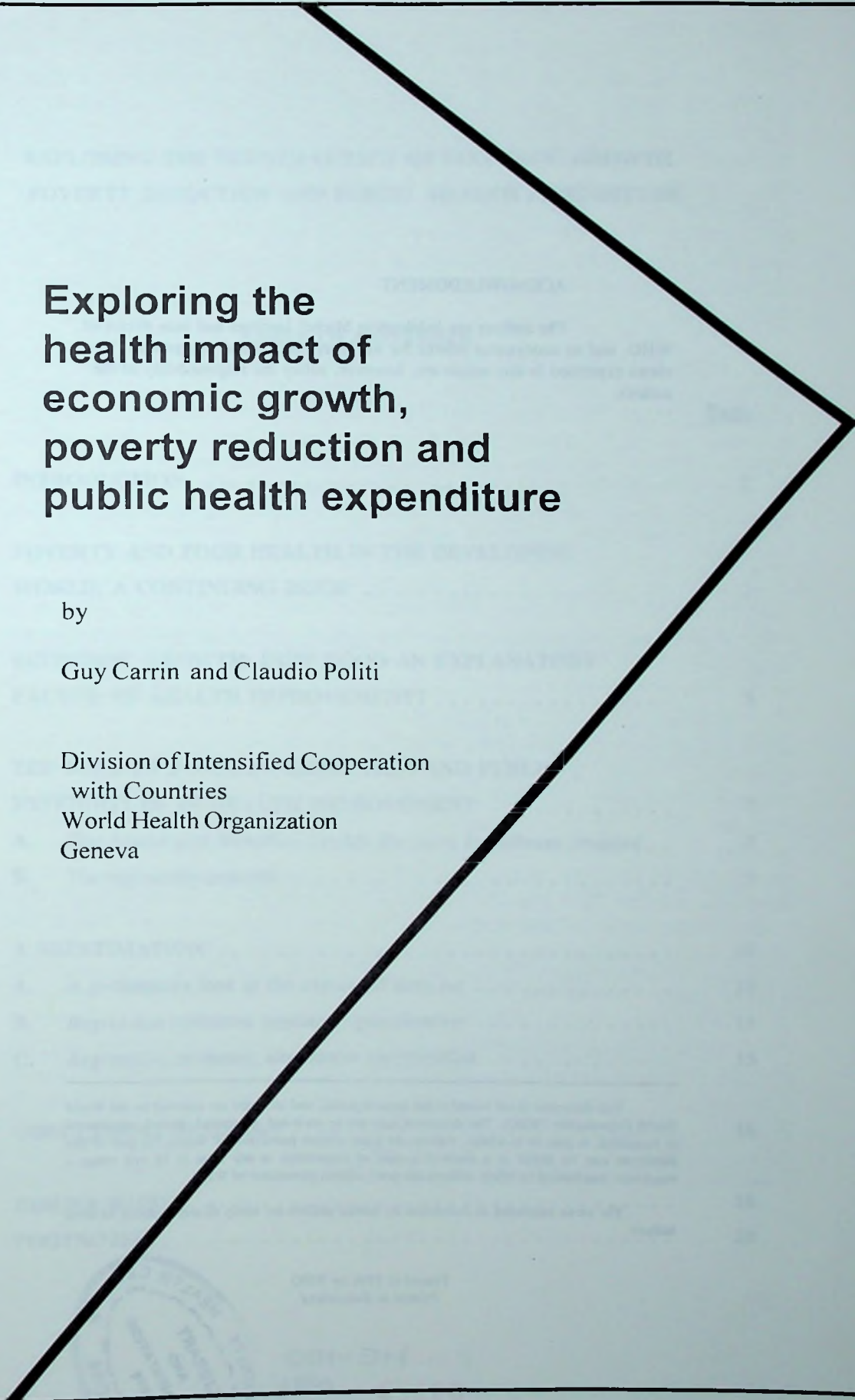**World Health Organization**
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Exploring the health impact of economic growth, poverty reduction and public health expenditure

by

Guy Carrin and Claudio Politi

Division of Intensified Cooperation
 with Countries
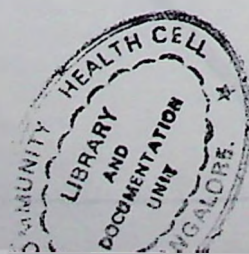World Health Organization
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EXPLORING THE HEALTH IMPACT OF ECONOMIC GROWTH, POVERTY REDUCTION AND PUBLIC HEALTH EXPENDITURE

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INTRODUCTION

It is true that, on the whole, developing countries have improved their health status over the past decades. However, this does not imply that the currently achieved health status in developing countries, especially that of the poorest, can be denoted as satisfactory. Often the immediate response to this caveat is that developing countries should continue to grow and that, eventually, economic growth will trigger sufficient human development. The purpose of this paper is now to see to what extent variables other than sheer economic development play a role in health status improvement. In particular, we study the impact of poverty reduction and public health expenditure in developing economies on health. The latter variables are often quoted as necessary for the improvement of developing countries' health status.

In the first section, we give a short overview of some basic indicators of poverty and health in developing countries, and thus illustrate that poor health in the developing world is a pressing problem. In section II, we address the question to what extent income growth is associated with health improvement. Then, the results obtained by Anand and Ravaillon (1993) regarding the roles of poverty reduction and public expenditure for health improvement are discussed in section III. New findings from econometric analysis with a new and larger data set are presented in section IV. A summary of conclusions and indications for further applied research are presented in the final section.

I. POVERTY AND POOR HEALTH IN THE DEVELOPING WORLD: A CONTINUING ISSUE

The basic cause of poor health in developing countries is poverty. An immediate and simple way to indicate the presence of poverty in developing countries (DCs) is to measure the extent to which income is inadequate for these countries' populations. Informative results are obtained when Chen et al. (1993) estimate changes in absolute poverty[1] incidence between 1985 and 1990 in 40 selected countries[2]. A poverty line corresponding to average daily spending of $1 at 1985 purchasing power parity[3], is used to obtain these estimates. The absolute poverty incidence, as an aggregate for the selected sample of countries, declines only marginally between 1985 and 1990: from 33.3% to 33.1% of the population. The latter implies that the number of poor people has grown more or less according to overall population growth, viz. about 2% per year. For all developing countries, it is estimated that out of a total population of 4,240 million, 1,314 million live in poverty, but especially in rural areas (UNDP, 1994).

The basic needs approach introduced in the early seventies (ILO, 1976) broadened the approach to poverty, and advanced that social indicators such as health status and literacy are as important in revealing poverty as income itself. In fact, an indicator such as the Physical Quality of Life Index was proposed as a weighted average of income, life expectancy and literacy (Morris, 1979). The more recent Human Development Indicator proposed by the United Nations Development Programme (UNDP, 1994) has a similar underpinning, in that

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it is based on four indicators: life expectancy, literacy, years of schooling and income. The multidimensional character of poverty is also stressed by Gunatilleke (1995). He writes that[4] poverty "is a condition which encompasses deprivation in a variety of forms: inadequate income, lack of education, knowledge and skill, poor health status, lack of access to safe water and sanitation, insufficient food and nutrition, lack of control over the reproductive process".

For the purpose of this paper, we concentrate on the evolution of health status measures in the developing countries, however. When looking at global indicators of health such as life expectancy at birth or infant mortality, the developing countries as a group made a definite progress. Whereas average life expectancy was 46.2 in 1960, it rose to 63 in 1992[5]. And infant mortality decreased from 149 per 1000 in 1960 to 69 per 1000 in 1990. Despite these relative improvements, it should still be noted that currently 12.2 million children under age 5 die, most of them from causes that could be prevented[6]. Also the existing gap with industrialized countries is notable: life expectancy was 69 in 1960 and increased to 74.5 in 1992. The infant mortality rate in industrialized countries was 35 per 1000 in 1960 and 13 per 1000 in 1992[7].

As we focus on the least developed countries (LDCs)[8], it is clear that a special effort is needed to enhance the health status of their populations and to reduce the gap with respect to the industrialized world and even other developing countries. In the early 1990s, the average life expectancy at birth of these countries was only 50.1 years and the average mortality rate for children under the age of five was 160 per 1000 live births. Average maternal mortality was 730 per 100 000 live births in 1988. These figures confirm a blatant inequality with the rest of the world. In fact, average life expectancy in the LDCs is about 67 % of that in industrialized countries. An excessively large gap is observed with regard to children's and women's health: the average mortality rates of children under five and of mothers are at least 10 and 30 times as high, respectively, as the corresponding rates in industrialized countries. A comparison with other developing countries gives the following result: life expectancy in LDCs is about 78% of that the other developing countries; average mortality rates of children under five and of mothers are 2.4 and 2.7 times as high.

II. ECONOMIC GROWTH: HOW GOOD AN EXPLANATORY FACTOR OF HEALTH IMPROVEMENT ?

The basic question is to what extent overall economic development can reduce poverty and thus mediate the progress in health. The mechanism is that higher average incomes increase households' opportunities to achieve better education, health care, nutrition and improved living standards in general. In turn, this rise in opportunities contributes to a better health status. The present reasoning can also be referred to as the trickle-down approach to social development. The potential for economic growth to facilitate health development was highlighted earlier by Attinger and Ahuja (1980). Ram (1985) is another proponent of the idea that economic development will positively affect the fulfillment of basic needs. In their study of human development in poor countries, Anand and Ravallion (1993) also mention economic

growth as a first possible determinant of human development as measured by health status and the literacy rate.

In Figures 1 to 3, we depict the relationship between life expectancy at birth, infant mortality and underfive mortality vs. Gross Domestic Product (GDP) per capita in $[9], for 1990. The data, represented by squares, are for 84 developing countries. These data pertain to 32 least developed countries[10] and 52 other developing countries. The size of the sample was constrained by data availability on the set of health status indicators and health status determinants in 1990 that is used in the econometric analysis in section IV[11].

A quick glance at Figures 1 to 3 suggests easily that, on average, economic development enhances health status: the higher the level of GDP per capita, the higher life expectancy and the lower infant mortality and underfive mortality. The latter is confirmed by three simple regression analyses. The dependent variables are the natural logarithms of life expectancy (LE), the infant mortality rate (IMR) and the underfive mortality rate (U5MR), respectively. The explanatory variable in the three equations is the natural logarithm of GDP per capita (GDPC). The results of the regression equations, estimated by ordinary least squares, are given in Table 1.

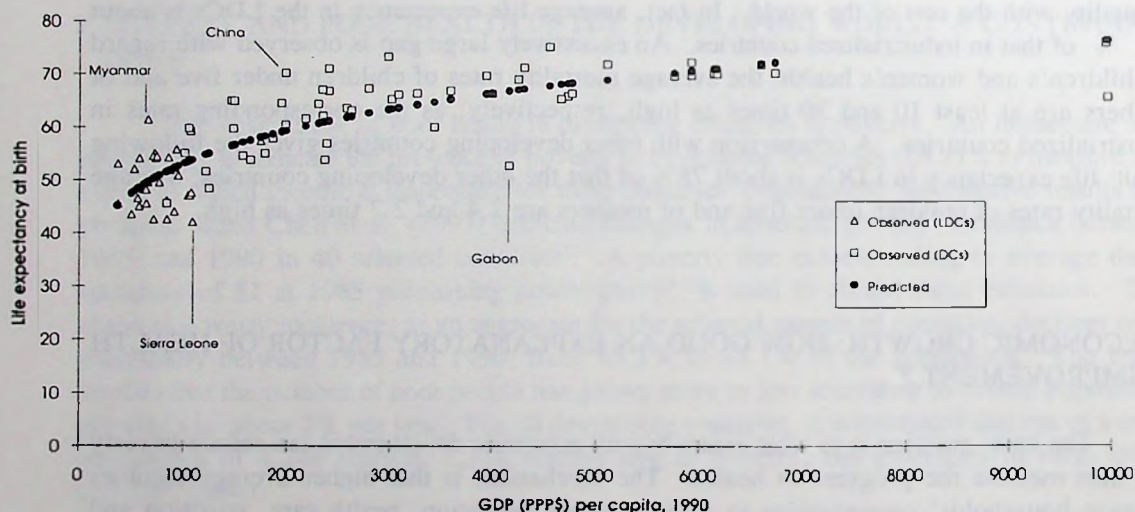**Figure 1 Relationship between Life Expectancy and GDP per capita**

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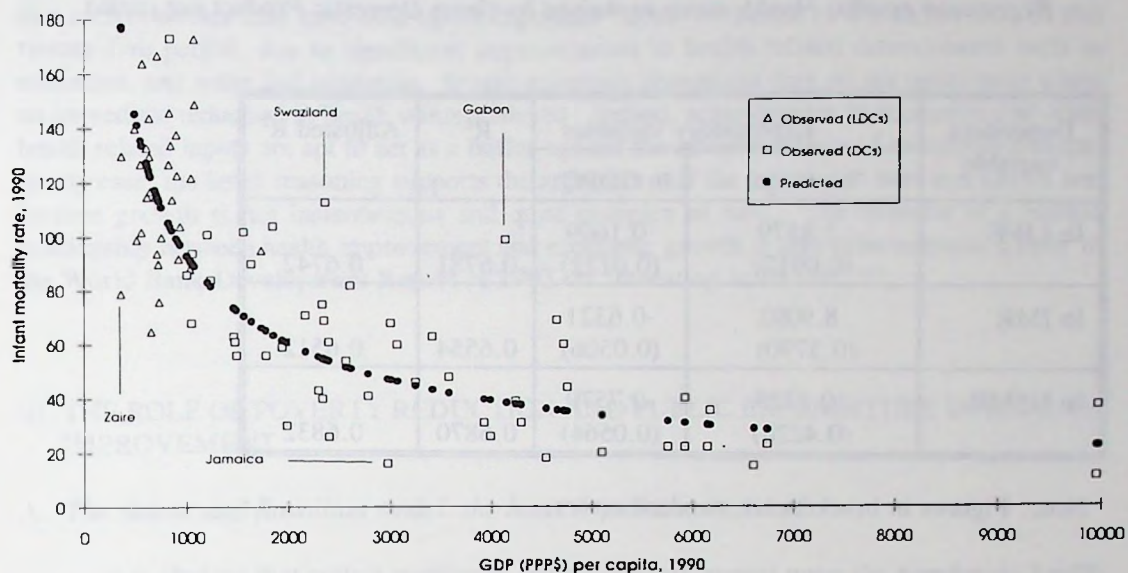**Figure 2 Relationship between Infant Mortality Rate and GDP per capita**

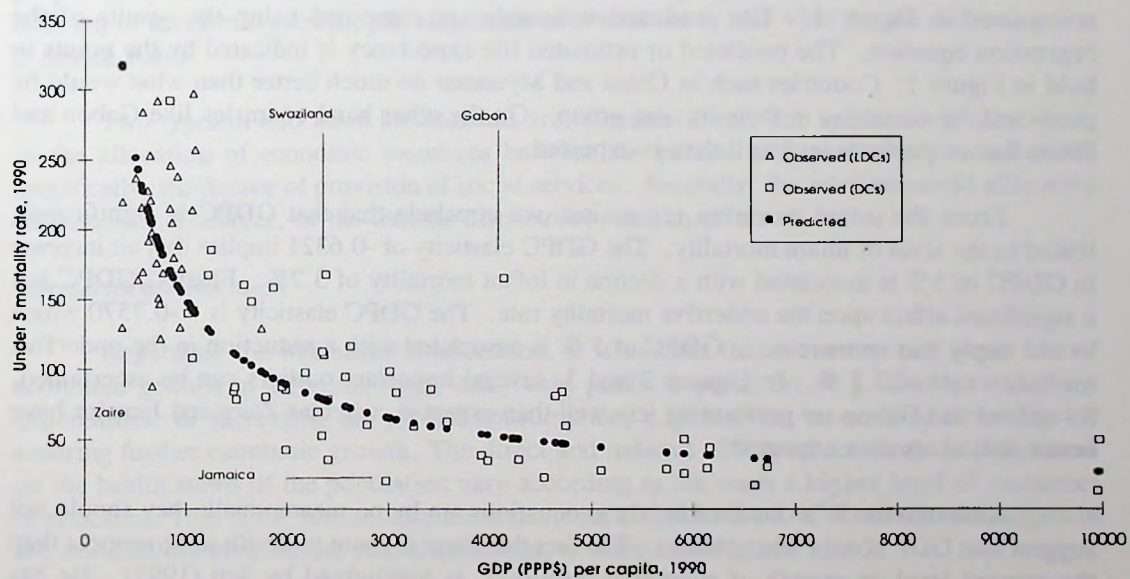**Figure 3 Relationship between Under 5 Mortality Rate and GDP per capita**

Table 1

Regression results: Health status explained by Gross Domestic Product per capita

Dependent variable	Explanatory variables		R²	Adjusted R²
	intercept	ln GDPC		
ln LIFE	2.8579 (0.0917)	0.1609 (0.0122)	0.6781	0.6742
ln IMR	8.9092 (0.3790)	-0.6321 (0.0506)	0.6554	0.6512
ln U5MR	10.2329 (0.4226)	-0.7570 (0.0564)	0.6870	0.6832

Note: Figures in brackets are standard errors

In the life expectancy regression, the GNPC elasticity is quite important, and is statistically significantly different from zero at the 1% confidence level. This regression implies that an extra 5 % growth in GNP per capita translates into an increase of life expectancy of 0.8%[12]. Several important outliers vis-à-vis the 'predicted' indicators can be recognized in Figure 1. The predicted indicators are computed using the results of the regression equation. The predicted or estimated life expectancy is indicated by the points in bold in Figure 1. Countries such as China and Myanmar do much better than what would be predicted for countries in their income group. On the other hand countries like Gabon and Sierra Leone perform less well than is expected.

From the infant mortality regression, we conclude that that GDPC is significantly linked to the level of infant mortality. The GDPC elasticity of -0.6321 implies that an increase in GDPC of 5% is associated with a decline in infant mortality of 3.2%. Finally, GDPC has a significant effect upon the underfive mortality rate. The GDPC elasticity is -0.7570 which would imply that an increase in GDPC of 5 % is associated with a reduction in the underfive mortality rate of 3.8 %. In Figures 2 and 3, several important outliers can be ascertained. Swaziland and Gabon are performing less well than expected, whereas Zaire and Jamaica have better indicators than expected.

Although the R²'s obtained for these equations are by no means small, they should not suggest that GDP is only what matters. The fact that there is more to health improvement than the current level or growth of economic resources, is highlighted by Sen (1993). He has demonstrated that the countries with a negative growth rate over the period 1960-1985 still observed an improvement in health indicators. For instance, the country that experienced the

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largest negative growth rate, namely Kuwait, with an average annual growth of GDP per capita of -5.82%, saw its under-five mortality decline annually by 6.32%. It is surely granted that such countries may have built up an important "stock" of health in the earlier part of this twenty-five period, due to significant improvements in health-related determinants such as education, and water and sanitation. Severe economic downturns then do not necessarily cause an immediate reduction in health status achieved. Indeed, achievements in education and other health-related inputs are apt to act as a buffer against the adverse effects of economic slumps. In any case, the latter reasoning supports the argument that the interaction between health and income growth is not instantaneous and quite complex as well. The absence of a unique relationship between health improvement and economic growth is also demonstrated amply in the World Bank Development Report of 1993 on "Investing in Health "[13].

III. THE ROLE OF POVERTY REDUCTION AND PUBLIC EXPENDITURE IN HEALTH IMPROVEMENT

A. *The Anand and Ravallion model: the basic hypotheses revisited*

It is obvious that quite a number of societal factors impact upon the population health levels. For instance, the population dynamics, the economy, the educational system, social infrastructure and the environment have main effects on health. One possible methodology to analyze these interactions is the construction of a multi-sectoral model. The scope of the present paper is far more modest, however. We will study and reinterpret a simple model proposed by Anand and Ravallion (1993). We basically agree with these authors that, in addition to economic growth, the **allocation of resources** is also vital for the determination of health status.

Two types of allocation mechanisms are relevant. First, the intersectoral allocation, or the allocation of economic resources between the private and public sector, and more specifically, the degree of provision of social services. Secondly, the interhousehold allocation of economic resources, or the income distribution, also matters.

Intersectoral allocation

Regarding the intersectoral allocation, it is evident that a country can make use of economic growth in different ways: enhancing public expenditure, e.g. health or military expenditure, or increasing the private consumption, e.g. housing or cars, or investing for ensuring further economic growth. The direct and indirect effects of economic improvement on the health status of the population vary according to the ways a higher level of resources is allocated. This is the reason why countries with a similar level of economic development are associated with different health outcomes, as shown in Figures 1 to 3.

We argue that it is the distribution of GDP or GNP[14] in favour of **public resources** for basic health services, including family planning and nutrition, as well as elementary education, that matters significantly for health improvement of all socio-economic population categories.

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Governments can make a good case for public expenditure for health and education. *First*, governments can invoke that these development activities entail considerable positive externalities. A consumption externality exists as soon as the consumption of a commodity or service by a consumer has an effect on other consumers' welfare. The externality is positive (negative) when the consumption by that consumer increases (reduces) the welfare of other consumers. In the health sector, vaccination activities can be said to result in positive externalities, when the vaccination of one patient or group of patients benefits other patients as well. To use this example further, letting the provision of vaccines depend strictly on private decision-making, would be sub-optimal: private citizens would not take account, or only insufficiently, of the importance of their decisions on other citizens. The government is an agency that could rectify this sub-optimality by duly taking account of the externalities and, hence, by assuming responsibility for the provision of the vaccines. In other words, government can correct this so-called market failure by seeing to it that these development activities are provided in satisfactory amounts. It is safe to say that, generally, social and economic development requires a proper input from government. Note that the complementary between publicly financed goods and services and private sector activities has already been emphasized by Barten (1970). A *second* reason for government expenditure in health and education is simply the concern for equity, whereby governments want to stimulate an equitable access to health and education. For instance, governments may want to allocate grants across regions in such a way that they advance especially the poorer regions. Governments may also wish to finance as well as provide health and education services themselves, so as to ensure that they reach the poor as well.

Income distribution

Interhousehold distribution of resources matters in that the spreading of wealth among the socio-economic groups plays a relevant role in translating economic growth in health benefits. A fairer distribution of **private income** leads to a better distribution of consumption of health services, food, shelter, sanitation and education across households. In turn, the latter results in a more equal distribution of health status. Still, we think the most urgent concern is not so much about the income distribution on the whole, but about the extent of poverty[15]. Indeed, especially poverty and ill health are very much intertwined. Poverty implies lack of food, safe water and sanitation, and basic health services. This lack is the overriding cause of insufficient health. In turn, ill health reduces people's ability to work or to secure income increases, thus sustaining poverty. In view of the synergistic relationship between poverty and ill health, poverty reduction is seen as a major instrument of health improvement. As the recent 1995 World Health Report states :" The link between health and poverty should be obvious, as poverty has continued and will continue to be a major obstacle to health development"[16].

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B. *The regression estimate*

The considerations above, based on Anand and Ravallion (1993), can best be reflected in the following simple equation:

HS = HS (GNPC, PESS, POV)   (1)

where   HS   =   health status indicator
               GNPC =   gross national product per capita (PPP)
               PESS =   public expenditure on social services
               POV   =   poverty indicator

Anand and Ravallion subjected equation (1) to a regression analysis. The data used pertain to the years 1985-1990 and cover 22 selected developing countries. The health status indicator used is "the difference between desirable life expectancy (80 years) and actual life expectancy (LE)". To represent government's effort for social services, they restricted themselves to the variable "public health expenditure per capita" (PHEC). Poverty is measured via the "proportion of the population consuming less than $1[17]" (POP < 1).

A loglinear specification is used for the regression. Also note that the natural logarithm of the health status variable is multiplied by -1. In this way, one measures the impact of the explanatory variables on a reduction in the shortfall of observed from desirable life expectancy. The coefficients associated with GNPC and PHEC are expected to be positive, whereas the coefficient associated with POP < 1 is expected to be negative.

The results obtained are presented in Table 2. The GNPC elasticity has the wrong sign and is not statistically significant. The coefficients associated with the determinants POP < 1 and PHEC have the expected sign, and are statistically significant. Anand and Ravallion do remark that the correlation between GNP per capita and public health spending per capita is 0.91. Yet, they do not discuss the possibility that multicollinearity might have caused the coefficient of GNPC to be negative and not significantly different from zero. For Anand and Ravallion (1993, p.142), the result obtained does not indicate that GNPC is unimportant, however. They notice that the result "...says that the importance of growth lies in the way that its benefits are distributed between people, and the extent to which growth supports public health services".

Several doubts have also to be expressed regarding the validity of the PHEC variable. *First*, public health expenditure contains both current and capital expenditure. All of this expenditure is not necessarily geared to basic health services. For instance, investment in the construction of a university hospital, and the subsequent health services provided, is likely to be less important for basic health than basic primary health care services and prevention. In fact, in many developing countries half of public health expenditures are allocated to hospital services that are not accessible to the larger part of the population[18]. Hence, by construction, PHEC is not a very valid indicator, as it does not completely reflect what we intend to measure. In addition, public health expenditure incorporates government expenditure at the central level only. Hence, PHEC may be biased downwards for countries with important

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provincial or municipal health expenditure. *Secondly*, it is very difficult for the current PHEC variable to take account of the efficiency of the public health expenditure. Some government budgets may be sufficiently important in terms of GDP, but their effectiveness is not adequately revealed. Public health expenditure is effective as long as there is a proper mix of inputs. A public health budget that allocates most of its budget to salaries at the detriment of, say, vaccines or pharmaceuticals, is likely to entail inefficiencies. *Thirdly*, public health expenditure needs to be properly complemented by other expenditure essential for health improvement. For instance, sanitation infrastructure and water development positively influence health. Also private health expenditure may be needed as a complement to public health expenditure in many countries. Currently the importance of these complementary factors is captured, but in an indirect way only, via the GDPC variable.

Table 2
Regression result: life expectancy regression from Anand and Ravallion (1993)

Dependent variable	Explanatory variables				R^2
	intercept	ln GNPC	ln POP < 1	ln PEHC	
- ln LE (80-LE)	-1.08 (0.46)	- 0.28 (0.21)	-0.21 (0.04)	0.30 (0.10)	0.71

Note: Standard errors are in brackets

IV. A REESTIMATION

A. *A preliminary look at the expanded data set*

We reestimate equation (1), but utilizing the larger data set for 1990 referred to earlier in section II. We also modify two of the three explanatory variables. First, in our analysis, public effort for public health is measured via the share of public health expenditure in GDP (PHE%). We are not disregarding here our own reservations, expressed earlier, about the validity of public health expenditure as an indicator. Still, we are interested to see whether similar econometric results are obtained when government's commitment to health is measured differently. Secondly, poverty is measured either by the incidence of total absolute poverty (TPOV) or by absolute rural poverty (RPOV)[19]. In addition to life expectancy, we retain two other health status variables for further study, namely infant mortality and underfive mortality.

As an initial exercise, we rank the countries according to the sign of the residuals estimated in the life expectancy equation presented in Table 1[20]. A negative residual means that the country does less well than expected, whereas a positive residual is associated with a country that performs better than expected. Next, we select the first 10 countries with

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the highest positive deviation from estimated life expectancy (we call these the "high" performers). We also select the first 10 countries with the highest negative deviation from estimated life expectancy (we call these the "low" performers). We refer to Table 3 for the comparison between the high and low performers.

From section II, we already know that GNPC is highly correlated with health status. Therefore, we focus on possible differences in public health expenditure and the poverty indicator between the high and low performers. **Public expenditure** as a share of GNP varies widely both in the group of high and low performers, respectively. In particular, the first group has a range from 0.8% of GNP (Myanmar) to 5.6% (Costa Rica) with an average of 3% of GNP spent on health. The countries with observations below the predicted life expectancy in Figure 1 have a similar varying pattern, from 1.3% (Guinea Bissau) to 5.5% (Mauritania), with an average of 2.5% of GNP. It is striking that there is no clearcut difference in the importance of public health expenditure, as a % of GDP, between the two groups.

Further analysis investigating the role of poverty indicates that the **level of rural poverty** is substantially higher in the low performers as compared with the high performers. The 10 selected countries below the expected line in Figure 1 have an average of 63% of the rural population below the absolute poverty line. However, the 10 selected countries who performed better, that is with higher life expectancy than predicted, have an average of 49% of absolute rural poverty. This is already some indication that the level of poverty matters in the explanation of differences in health status across countries. Unfortunately, it proves to be difficult to compare total absolute poverty between the high and low performers, due essentially to lack of data.

A similar analysis based on the residuals estimated in the infant mortality and underfive mortality equations was performed. In general, similar conclusions as above are obtained. These analyses are therefore not reported separately.

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Table 3
Comparison between high and low performers

Countries	Deviation from expected life expectancy (%)	GDP per capita	Absolute Poverty (%)		Public Health Expenditure (% of GDP)
			Total	Rural	
HIGH PERFORMERS					
Myanmar	23.8	659	35	40	0.8
China	18.5	1,990	9	13	2.1
Zaire	17.6	367	70	90	0.8
Sri Lanka	16.2	2,405	39	46	1.8
Jamaica	15.8	2,979	na	80	2.9
Honduras	15.2	1,470	37	55	2.9
Nicaragua	14.7	1,497	20	19	6.7
Kenya	11.7	1,058	52	55	2.7
Tanzania	11.6	572	58	60	3.2
Costa Rica	10.9	4,542	29	34	5.6
average	**15.6**	**1,754**	**39**	**49**	**3.0**
LOW PERFORMERS					
Congo	-11.7	2,362	na	80	3.0
Benin	-11.9	1,043	na	65	2.8
Senegal	-12.0	1,248	na	70	2.3
Mauritania	-12.1	1,057	na	80	5.5
Oman	-14.1	9,972	na	6	2.1
Afghanistan	-15.3	714	53	60	1.6
Gambia	-15.7	913	na	85	1.6
Guinea-Bissau	-17.5	841	na	75	1.3
Gabon	-21.2	4,147	na	41	3.2
Sierra Leone	-21.7	1,086	na	65	1.7
average	**-15.3**	**2,338**	**53**	**63**	**2.5**

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B. *Regression estimates: loglinear specification*

The econometric analysis focuses on the roles played by GDP per capita (GDPC), public health expenditure as a % of GDP (PHE%) and total absolute poverty (TPOV) in the determination of the three health status variables. The data sample consists of 57 countries. We first use a loglinear specification to estimate the various effects. This has the known advantage that the coefficients immediately measure the elasticities. The latter elasticities are constant, however. The results are reported in Table 4.

Impact of GDP per capita

A first conclusion is that the coefficients indicating the GDPC elasticities are all statistically significantly different from zero at the 2.5% significance level. Also notice that the absolute values of all coefficients are less, though not in a very important way, than those obtained from the simple regressions of health status on GDPC (see Table 1). In any case, these results suggest that the overall level of economic resources remains important for the determination of health status. Indeed, health is not only dependent upon medical care per se. The state of health is heavily intertwined with the overall process of resource generation, as the latter creates more opportunities to achieve better health.

Using the econometric results, we can compute that an increase of 10 % in the level of GDP per capita would result in an increase of life expectancy by about 1.4 % (= 0.1360 x 10%). And a 10 % increase in GDP per capita decreases infant mortality and underfive mortality by about 4.8% (= 0.4848 x 10%) and 5.8% (0.5812 x 10%), respectively[21].

Impact of poverty

The coefficient of the poverty variable (TPOV) has the expected sign: a negative sign in the life expectancy equation (higher levels of poverty are associated with lower life expectancy) and a positive one in the mortality equations (higher poverty levels are correlated positively with the mortality rates). The coefficients in the life expectancy and mortality equations are statistically significantly different from zero at the 5% and the 2.5% significance level, respectively.

The level of the estimated poverty elasticities are clearly more important in the mortality equations than in the life expectancy equation. This suggests that poverty hits the youngest population groups harder than other population categories. To appreciate further the impact of poverty, let us calculate the effect of a halving of the average poverty level (from 43.49 to 21.75) on the health status variables. Let us calculate this impact for countries whose variables, initially, take on average sample values (59.76 years, 77.40/1000 and 119.32/1000 for life expectancy, infant mortality and underfive mortality, respectively). Using the coefficient estimates, we then calculate that a 50% drop in poverty means an extra 1.7 years to life expectancy, and leads to a reduction of 14.94 per thousand and 27.47 per thousand in infant mortality and underfive mortality, respectively. Notice, however, that the magnitude

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of these impacts decreases with higher levels of health status. The latter is a specific feature of the logarithmic specification.

Impact of public health expenditure

The PHE% variable does not have the impact that could be anticipated on the basis of the regression presented in section III. The coefficients do not have the correct sign and, in addition, are not statistically different from zero either. We cannot really blame multicollinearity[22] between GDPC and PHE% for this result, as the correlation coefficient between those variables is a mere 0.038. It seems that our doubts regarding the PHE% variable are supported by this result. We reiterate that government's effort for basic health services is reflected inadequately by public health expenditure.

Two examples are given to illustrate that public health expenditure as a share of GDP is insufficiently linked to health status. For instance, Madagascar and Myanmar have a similar GDP per capita. Myanmar allocates less of its GDP to health than Madagascar: 0.8% vs. 1.3%. Yet, Myanmar's life expectancy exceeds that of Madagascar: 61.3 years vs. 54.5 years. Another example is that of Somalia and Angola that both have a similar GDP per capita. Angola spends double the amount on public health as compared to Somalia, yet they arrive at a similar life expectancy. The latter illustrates that other factors are at work that are not adequately captured via our simple regression model.

Do the impacts change when absolute rural poverty is used as the poverty indicator ?

All equations were reestimated, using absolute rural poverty (RPOV) instead of total absolute poverty (TPOV). The data sample is larger in this case, viz. 84 countries. The results obtained are similar to those reported in Table 4, in two respects[23]. First, the values of the GDP elasticities are quite alike. Secondly, the PHE% coefficients are not statistically different from zero. We found that the poverty elasticities remain statistically different from zero; yet, they assume values that are approximately half of the values of the elasticities reported in Table 4. The latter is not unexpected given that rural poverty is an imperfect indicator of a country's poverty. Still, it is interesting to note that the poverty effects are confirmed, subsequent to using another data set and a different poverty indicator.

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Table 4

Regression results: Loglinear specification

Dependent variable	Explanatory variables				R^2	Adjusted R^2
	intercept	ln GDPC	ln TPOV	ln PHE%		
ln LIFE	3.2215 (0.1777)	0.1360 (0.0162)	-0.0410 (0.0208)	-0.0077 (0.0190)	0.7414	0.7268
ln IMR	6.8150 (0.7888)	-0.4848 (0.0721)	0.2548 (0.0921)	0.0947 (0.0844)	0.6966	0.6794
ln U5MR	7.7535 (0.8629)	-0.5812 (0.0789)	0.2990 (0.1008)	0.0935 (0.0923)	0.7317	0.7165

Note: The figures in brackets are standard errors.

C. *Regression estimates: alternative specification*

A further question is whether the use of another specification would produce similar conclusions. We therefore tested one alternative specification, which also takes account of the natural bounds of the dependent variables. In the case of infant mortality and underfive mortality, a logistic curve is estimated. This specification ensures that estimated values from the regression will be positioned between 0 and 1. The estimation of a logistic curve for life expectancy proves to be somewhat cumbersome. Therefore, a logarithmic reciprocal-type model is estimated; the latter ensures that the estimated life expectancy is between 0 and a maximum value.

The results are presented in Table 5 and 6. In general, the conclusions from section 4.2 apply. PHE% is not statistically significantly different from zero. Both the coefficients of GDPC and TPOV remain significantly different from zero. Note, however, that the explanatory power of the current life expectancy regression is weaker than in the case of the logarithmic specification.

In contrast to the previous estimates, the elasticities implied in the current regression equations are no longer constant, however. For instance, at average levels for the dependent variables and poverty indicator, the poverty elasticities of infant mortality and underfive mortality are 0.2568 and 0.3317, respectively. And in the case of the life expectancy equation, the poverty elasticity of life expectancy is -0.0225. However, at maximum levels for the dependent variables and the poverty indicator, the implied poverty elasticities of infant mortality and underfive mortality are 0.4500 and 0.5175, respectively. And the poverty elasticity of life expectancy becomes -0.0115.

These alternative specifications were also used to undertake reestimations with absolute rural poverty as the poverty indicator[24]. The GDPC coefficients are quite similar to those reported in Tables 5 and 6. Again, the PHE% variable does not exert a statistically significant effect on health status. The poverty coefficients are all statistically significantly

different from zero at the 2.5% significance level. It is to be noted that the poverty coefficients in the mortality equations are about half as large as those reported in Table 6, however. Still, the results concerning the impact of poverty are generally coherent with those that were obtained when TPOV was used as the poverty indicator.

Table 5

Regression result: logarithmic reciprocal specification for the life expectancy regression

Dependent variable	Explanatory variables				R^2	Adjusted R^2
	intercept	1/GDPC	1/TPOV	1/PHE%		
ln LE	4.1649 (0.0346)	- 166.363 (20.4516)	0.9793 (0.3957)	0.0225 (0.0387)	0.6616	0.6425

Note: The figures in brackets are standard errors.

Table 6

Regression results: logistic specification for the mortality regressions

Dependent variable	Explanatory variables				R^2	Adjusted R^2
	intercept	GDPC	TPOV	PHE%		
ln IMR/1-IMR	-2.4206 (0.2182)	-0.00025 (0.00003)	0.0064 (0.0030)	0.0347 (0.0371)	0.6858	0.6680
ln U5MR/1-U5MR	-1.9752 (0.2525)	-0.00030 (0.00004)	0.0087 (0.0035)	0.0364 (0.0429)	0.7133	0.6972

Note: The figures in brackets are standard errors.

V. CONCLUDING REMARKS

Among the most important findings from this analysis is the support for the hypothesis that poverty reduction is important in the determination of health status indicators. The analysis shows that lower rates of total or rural absolute poverty are associated with better health status. Whereas this may seem intuitively obvious, econometric analyses that highlight the role of poverty are relatively scarce. Furthermore, in our analysis, GDP per capita keeps its role in determining health status, unlike the finding by Anand and Ravallion (1993). It can be understood that the level of income and its growth provide an important support for health development in developing countries. In fact, the growth in the volume of economic resources is apt to facilitate the financing of inputs, like water and sanitation infrastructure, that are often as important for health as medical services.

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We do not obtain, however, the result reported by Anand and Ravallion (1993), namely that public health expenditure has a statistical significant effect on health status. In view of the current analysis, one can question whether their result can be extrapolated to a larger set of countries. One of the main reasons we submit for our finding is that the government effort to finance basic health services is not captured well by the PHE% variable. Moreover, the PHE% does not take account of the extent to which public health service systems are efficient. Indeed, a significant level of public health expenditure may hide large inefficiencies, whereas a modest level of public health expenditure may result in a quite performing system. It is precisely this difference in efficiency that is of capital importance for health status. In addition, PHE% does not capture efforts to finance the complementary determinants of health such as sanitation and water infrastructure and basic education.

Which recommendations could be made for future empirical research in this area ? First, it is clear that indicators should be used that better reflect the true public effort for basic health services. Secondly, explanatory variables reflecting expenditure for infrastructure and basic education may have to be considered as well. In addition, the level of private health expenditure can be introduced among the set of explanatory variables. Thirdly, the impact of poverty can be reassessed via the use of the other poverty indicators or inequality indicators such as the GINI coefficient. Of course, the application of these recommendations risks to be hampered by the lack of international data. Fourthly, an important question is to what extent the level and distribution of economic resources is not, in turn, influenced positively by the state of health. A single regression approach then no longer suffices. In other words, we may well have to consider the study of poverty and health via a simultaneous modeling framework.

Finally, although the health policy maker may appreciate that part of his intuition is confirmed, he may want to express greater expectations towards the economist. It is evident that most of the health policy decisions are being taken at country level. Hence, a fruitful line of research would be the analysis of the relationship between health status, on the one hand, and socio-economic variables, on the other hand, using data on a country's regions or districts. It is hoped that the use of variables on economic activity, on poverty and income distribution, and on the use of public and private health expenditure at a more micro-level would result in firmer and more useful conclusions for policy making.

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FOOTNOTES

1. Chen et al. (1993) define absolute poverty as a situation whereby one can no longer satisfy the basic needs of food, clothing and shelter.

2. These are developing countries belonging to East Asia, Latin America, Middle-East and North Africa, South Asia and Sub-Saharan Africa and countries belonging to Eastern Europe.

3. Note that countries' dollar exchange rates, expressed in purchasing power parity (PPP), reflect these countries' true purchasing power. Thus, PPP exchange rates allow one to compare countries' real consumption baskets.

4. Gunatilleke (1995, p.2).

5. UNDP (1994).

6. WHO (1995).

7. We also wanted to analyze the evolution of the underfive mortality rate. However, data for 1960 were not readily available to us.

8. Least developed countries are part of "A group of developing countries that was established by the United Nations General Assembly. Most of these countries suffer from one or more of the following constraints: a GNP per capita of around $300 or less, land-locked location, remote insularity, desertification and exposure to natural disasters" (UNDP, 1994).

9. GDP per capita is measured at purchasing power parity (PPP) exchange rates.

10. The UNDP classifies Botswana as a LDC. However, given its level of GDP per capita, we chose to rank it in the group of other developing countries.

11. The data collected are all from UNDP (1992), UNDP (1993) and UNDP (1994).

12. These calculations are approximations, as the computation of the impact (coefficient times the change in the explanatory variable) is only truly correct for small changes in the explanatory variables.

13. World Bank (1993, ch.3).

14. Note that Anand and Ravallion (1993) use GNP for their empirical analysis.

15. Some authors would continue to stress the role of the income distribution, however. For instance, Waldham (1992) arrives at the anomolous result that a country, with the same real income as another country, but in which the rich are wealthier, has a higher infant mortality.

16. WHO (1995, p.40).

17. At PPP values.

18. For data on the allocation of public health expenditure, see WHO (1994).

19. The poverty line is defined by the UNDP (1994, p.221) as "that income level below which a nutritionally adequate diet plus essential non-food requirements are not available". Also note that when TPOV is used to measure poverty, the data set consists of 57 countries. Due to better data availability on rural poverty, the data set consists of 84 countries when RPOV is used.

20. Recall that for the estimation of this equation, the data set of 84 countries was used.

21. See endnote 12.

22. See Barten (1989, p.194) on the multicollinearity problem.

23. For reasons of space, they are not reported here. The detailed results can be obtained from the authors, however.

24. The results can be obtained upon request.