Open access • Journal Article • DOI:10.1108/03068290410515501

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Published on: 01 Jan 2004 - International Journal of Social Economics (Emerald Group Publishing Limited)

Topics: Income distribution, Income inequality metrics, Adjusted gross income, Per capita income and Total personal income

Income Inequality and Health: A Multi-Country Analysis

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Keywords *Income inequality, Income inequality hypothesis, Health status*

Abstract *This paper investigates the effect of income inequality on health status. A model of health status was specified in which the main variables were income level, income inequality, the level of savings and the level of education. The model was estimated using a panel data set for 44 countries covering six time periods. The results indicate that income inequality (measured by the Gini coefficient) has a significant effect on health status when we control for the levels of income, savings and education. The relationship is consistent regardless of the specification of health status and income. Thus, the study results provide some empirical support for the income inequality hypothesis.*

Introduction

Why are some communities (or societies) healthier than others? Is it simply because they are wealthier and can therefore afford better nutrition and health care, or are there other significant factors at play? These questions have preoccupied researchers and policy analysts for the last three decades. The issues of poverty and disease have again dominated the policy agenda within the last few years. At the Millennium Summit held at the UN headquarters from 6-8 September 2000, world leaders agreed to a global agenda of, among other things, reducing poverty, disease, hunger, illiteracy, and environmental degradation by 2015. This agenda has been referred to as the Millennium Development Goals. Poverty and disease were again at the forefront of the World Summit on Sustainable Development held in Johannesburg from 26th August to 4th September 2002. The issue of health has become important because it is now viewed as a critical input into

* A previous version of this paper was published as Working Paper 487, Swedish School of Economics and Business Administration, Helsinki, Finland.

poverty alleviation, economic growth and long-term economic development (World Bank, 1993; Smith, 1999).

Within the last five decades, the world has seen remarkable gains in health outcomes. Average life expectancy in developing countries that stood at 40 years in 1950 increased to nearly 60 years by 1999 (World Bank, 2001). The gains in health outcomes have been made possible by improvements in sanitation, nutrition and primary health care, just to mention a few. However, despite this progress, there still remain glaring disparities between and within countries. For example, a child born in a high-income country can expect to live for 78 years, while a child born in a low-income country can expect to live for only 59 years (World Bank, 2001). In Sub-Saharan Africa, human development has actually retrogressed within the last two decades, and trends in health have remained stagnant or declined. It is quite obvious that many of these countries will be unable to achieve the Millennium Development Goals by the target date, and there is therefore a need to seek policy remedies at the present time.

At the individual level, it has been established both theoretically and empirically that richer people have better health because they can afford goods and services (e.g. medical care, better nutrition, sanitation and housing) that promote health. However, at the aggregate level, this relationship is by no means universal. There are some low-income countries (e.g. Costa Rica and Cuba) that have quite high health outcomes[1]. On the other hand, the U.S., the wealthiest country in the world in terms of per capita GDP, ranks 12th overall on 16 indicators of health outcomes amongst industrialised countries (Starfield, 2000). Thus, at the aggregate level, it cannot be assumed that income is the sole determinant of health.

The purpose of this paper is to determine whether there is an effect of income inequality on health. The link between income inequality and health is an issue of major concern and has important policy implications. At the same income level, a more unequal society might be expected to have a greater number of poor people. Given the concavity in the income-health relationship (i.e. diminishing returns to health with rising income), it is possible that redistributing income from the rich to the poor could improve average health outcomes (Kawachi and Kennedy, 1999). If this relationship is true, it would imply that efforts to reduce poverty and disease must not only concentrate on providing employment and primary health care, but must also target inequities in wealth distribution within and between countries. The paper is therefore motivated by the need to bring empirical evidence to bear on the inequality and health issue in order to propose appropriate policy interventions.

An important issue addressed in this paper is the possible interaction between health and income inequality. That is, at low-income levels people are more likely to fall sick (e.g. due to malnutrition) and therefore will be less able to work. Persistence of ill health within the population will then widen the income distribution due to the decline in individual income. To date, most of the studies on income inequality and health have used cross-sectional data and have concentrated mainly on developed countries. In this study, we use panel data for 44 countries covering six time periods. The analysis will help to determine whether the relationship between income inequality and health also holds in the *intertemporal* sense. Furthermore, we use a data set that includes a mix of developed as well as developing countries. In addition to increasing the degrees of

freedom, panel data enable us to disentangle the effects of socioeconomic and political variables on health because the countries are at different stages of economic development.

The paper is structured as follows. Section II briefly reviews the theoretical and empirical literature on the relationship between income inequality and health. Section III outlines the econometric framework and data used, and Section IV presents the empirical results. Section V concludes.

Literature Review

The idea that an individual's health is affected not only by his or her income, but also by the income inequality in the community or population has been referred to as the income-inequality hypothesis (IIH).[2] The relationship may be stated at the individual level as follows:

$$H_i = f_i(Y_i, I_p) \quad (1)$$

Where H_i is the health of the individual; Y_i is the individual's income; and I_p is the income inequality in the population. For the population as a whole, the relationship can be stated as follows:

$$H_p = f_p(Y_p, I_p) \quad (2)$$

According to the IIH, the greater the gap between the incomes of the rich and poor, the worse is the health status of the citizens (Wilkinson, 1996). The mechanisms by which different degrees of inequity in a society's income distribution might adversely affect health outcomes remain uncertain. Three possible explanations have been put forward (Wilkinson, 1996, Lynch and Kaplan, 1997). Firstly, an inequitable income distribution

is said to be linked with a set of economic, political, social and institutional processes that are indicative of disinvestments in human capital. Kaplan et al. (1996) found strong correlations between the degree of income inequality at the state level in the U.S. and indicators of human capital investment. For example, states with high-income inequality spent a smaller proportion of their budget on education. Reduced social expenditure (including educational expenditure) reduces opportunities for poor and middle-income households to improve their well being.

Secondly, a psychosocial link has been suggested in the income inequality-health relationship. It has been suggested that income distribution may directly influence individuals' perceptions of their social environment, which in term may adversely affect their health. It has been suggested that a high level of income inequality erodes "social capital" which is the stock of investments, resources and networks that produce social cohesion, trust and willingness to engage in community activities (Kawachi et al., 1997). Using data disaggregated at the state level, Kawachi et al. (1997) found strong cross-sectional correlations between indicators of social capital and mortality rates in the U.S.

Thirdly, from research in sociology, it has been suggested that frustration in communities (including the workforce) resulting from social comparisons can have adverse health consequences. Dressler (1996) argues that many communities have a single, shared cultural model of an acceptable standard of living that they strive to attain. To the extent that individuals fail to attain this standard, there may be adverse health effects. In studies conducted in the U.S. (Dressler, 1996) and Brazil (Dressler et al. 1999), it has been shown that the extent of departure from cultural consonance is the strongest

predictor of systolic blood pressure, even after adjusting for other risk factors such as skin colour, obesity, education and income.

The majority of studies that have attempted to test the IIH have been mainly within-county studies carried out in the U.S. A large number of these studies have used multilevel study designs that gather income data at both the individual and aggregate levels. The empirical results have been mixed. Kaplan et al. (1996) found a significant correlation between the percentage of total household income received by the less well-off 50% in each state and mortality from all causes, and this relationship was not affected when state median incomes were adjusted. Kennedy et al. (1996) also found strong correlations between income inequality and 'all-cause' as well as 'cause-specific' mortality in each state using the Robin Hood Index as a measure of inequality.[3]

Other studies that have shown a small effect of income inequality after adjusting for individual level income include Soobader and LeClere (1999), Mellor and Milyo (2001), and Diez-Roux et al. (2000). In a study of U.S. white males between the ages of 25 and 64 years, Soobader and LeClere (1999) found a significant income inequality effect only for the top quartiles of Gini coefficients. In a larger study, Mellor and Milyo (2001) found that state-level income inequality has a significant positive effect on the coefficient of variation as a measure of income inequality but not on other measures, and therefore concluded weak support for the IIH. In another multilevel study, Diez-Roux (2000) found that for three of the four risk factors investigated (BMI, hypertension, and sedentarism), state inequality was associated with increased risk factor levels, particularly at low-income levels (annual household incomes <$25,000), with associations persisting after adjustment for individual-level income.

In contrast to the above-mentioned studies, some studies have found no effects or inconsistent effects of income inequality on health. These include Fiscella and Franks (1997), Daly et al. (1998), and Mellor and Milyo (2001). In a study of US adults between the ages of 25 and 74 years, Fiscella and Franks (1997) found no general evidence to support the IIH. In a panel study of two cohorts, Daly et al. (1998) found no significant effect of any inequality measure on mortality risk for the total sample, thus rejecting the IIH. Finally, Mellor and Milyo's (2001) study found no effect of income inequality on individual health when household income is controlled for.

At the aggregate level, the seminal work on this topic was conducted by Preston (1975) who first showed that among poor countries, increases in average income are strongly associated with increases in life expectancy, but as income per head increases, the relationship flattens out, and is weaker or even absent among the richest countries. This observation (referred to as the Preston curve), led him to speculate that due to such a non-linear relationship, countries with a more equal distribution of income will have a higher average life expectancy. Deaton (2001) examined the relationship between income inequality and mortality for a sample of rich countries and found no effect. Ross et al. (2000) in a study of Canadian cities and provinces could not find a significant relationship at either level. However, in a similar study conducted for OECD countries, Wilkinson (1992, 1996) found strikingly negative associations, even after controlling for cross-country differences in income level. In a replication and extension of Wilkinson's studies, Judge (1995) found that the international correlations were sensitive to the particular measure of inequality and income used, although he concluded that the weight of the empirical evidence was "overwhelming". Most of the studies reported above have

examined the relationship between income inequality and health for advanced countries, in particular the U.S. At the aggregate level, there is need for studies such as the current one with a more inclusive sample of countries in order to unravel the relationship between income inequality and health. In particular, it is important to investigate whether there are other socioeconomic factors that influence the relationship between income inequality and health.

Methodology

Econometric Framework

On the basis of the foregoing literature review, we hypothesise that current health status is affected by previous levels of income and income inequality. We use levels of income, education, and savings as control variables. Income level is included because it is generally positively associated with health and negatively associated with income inequality. Education is an important variable because a more literate society has greater awareness of factors affecting health and is therefore better placed to take preventive measures, or seek medical assistance when ill. The level of savings in a country is used here as a proxy for the capacity to afford health care. Therefore, we expect a positive association between savings level and health status. The model can therefore be stated as follows:

$$H_{it} = \beta_0 + \Sigma_j\beta_{j1}Y_{it-1} + \Sigma_j\beta_{j2}Q_{it-1} + \Sigma_j\beta_{j3}SAV_{it-1} + \Sigma_j\beta_{j4}ED_{it-1} + u_{it} \quad (3)$$

where subscript *i* refers to a given country and subscript *t* is time, with *t* values of 1970, 1975, 1980, 1985, 1990 and 1995; *H* is health status; *Y* is income level; *Q* is income inequality; *SAV* is the level of domestic savings; *ED* is the level of education; and *u* is an error term. Equation (3) was estimated as a random effects model which assumes that the term β_{it} is the sum of a common constant β and a time-invariant cross-section specific random variable u_i that is uncorrelated with the residual ε_{it}. The model, comprising six equations and 44 cross-section units, was estimated as a system using Generalised Least Squares (GLS).

Equation (3) can be considered as a test of whether income inequality Granger causes health, except for the presence of the other additional explanatory variables. In that sense, it is a conditional test of Granger causality, given that the effects of the additional explanatory variables have been controlled. Thus, a significant β_{j2} would indicate that an increase in income inequality causes a decline in health status.

Data Definition and Sources

Three alternative measures of income were used: real per capita GDP (in 1995 constant US$), the human development index (HDI), and educational expenditure (percent of GDP). Income inequality was proxied by the Gini coefficient (which is measured from the Lorenz curve). Domestic savings was defined as the proportion of total domestic savings to GDP. Educational level was represented by the ratio of total enrolments in primary school to the population aged between 15 and 65 years of age. Two proxies of health status were used - life expectancy at birth (in years) and the infant mortality rate (the number of infants, per 1000 live births, who survive before the age of one year).

Estimates of the Gini coefficient were obtained from the World Institute of Development Economics Research's database, estimates for HDI were obtained from the UN's 1999 World Development Report, while the remaining variables were obtained from the 2000 World Development Indicators (World Bank, 2001). The choice of the countries in the sample was dictated mainly by the existence of a long enough time series for all the variables in the model. A complete data set was obtained for 44 countries (see Appendix 1). Combined with data for six time periods for each country, this amounted to 264 observations.

Table 1 reports summary statistics for the variables used in the analysis. Average life expectancy and infant mortality rate for the sample period for all countries are 67.7 years and 57.5 per 1,000 live births, respectively. Amongst developing countries, Latin America/Caribbean has the highest life expectancy (68.8 years) and lowest infant mortality (67.9 per 1,000 live births), while Africa ranks the lowest on both indicators.

[Table 1]

The Latin America/Caribbean region is the most unequal region with an average Gini coefficient of 49.12, followed by Africa with 42.92. The figures in Table 1 suggest that, with the exception of the Latin America/Caribbean region, areas with greater inequality tend to have lower health status.

Empirical Results and Discussion

Regression Results

Table 2 presents results for the case where life expectancy is used as a proxy for health status. Looking at the first set of results (Model 1), lagged income (represented by per capita GDP) has a significant positive effect on current health status, as expected.

[Table 2]

For example, a $100 increase in per capita income in the previous period increases life expectancy by 0.04 years or 2.08 weeks in the current period, holding all other variables constant. Income inequality (represented by the Gini coefficient) has a negative effect on health status, but is not statistically significant in this regression. Both the level of savings and education have positive effects on health status, as hypothesized. However, only the latter is statistically significant. In the second set of regressions (Model 2), educational expenditure is used as a proxy for income. Income has a significant positive effect, while income inequality has a significant negative effect on health status. For example, a one-unit increase in income inequality in the previous period reduces life expectancy in the current period by 0.036 years, holding all other variables constant. The coefficients of savings and education have significant effects on health, as postulated.

Per capita income is generally regarded as a narrow measure of economic development. The UN has developed an alternative measure, the HDI, which measures a country's achievements in three aspects of human development: longevity, knowledge, and a decent standard of living. Longevity is measured by life expectancy at birth; knowledge is measured by a combination of the adult literacy rate and the combined gross primary, secondary, and tertiary enrolment ratio; and standard of living is measured by GDP per capita (PPP US$). The third regression (Model 3) used the HDI as a proxy for income. Here, it can be seen that the coefficient of HDI is highly significant and

positive. Income inequality is also significantly related to health status. For example, a one-unit increase in income inequality is associated with a decline of 0.022 years in life expectancy. Educational level is also significantly positive, but the level of savings is not significant.

Table 3 presents results for regressions where health status is measured by the infant mortality rate.

[Table 3]

The first set of results (Model 4) represents the case where income is measured by per capita GDP. It can be seen that income has a negative effect on infant mortality, while inequality has a significant positive effect on infant mortality. A $100 increase in per capita income reduces infant mortality by 0.23 per 1,000 live births, *ceteris paribus*; a one-unit increase in inequality increases infant mortality by 0.61 per 1,000 live births, *ceteris paribus*. The level of savings is not significant, although educational level is significant. When the income variable is replaced with education expenditure (see Model 5), results similar to Model 4 are obtained.

The last set of regressions in Table 3 represents the case where income is proxied by HDI (see Model 6). It can be see that income inequality has a negative effect on infant mortality, although this is not as strong as in the previous cases. Once again, it can be observed that both the level of savings and education have a negative effect on infant mortality, although only the latter is statistically significant

In the final set of regressions, we investigate whether the right handside variables have differential effects on health in low-income as compared to high-income countries. A cut-off income of level US$5,000 per capita was used to group the sample into low-

and high-income countries. This division resulted in a sub-sample of 20 high-income and 22 low-income countries.

Models 7 and 8 (see Table 4) present results for low-income and high-income countries, respectively, where health status is proxied by life expectancy. Here, it can be seen that income inequality is a strong determinant of health outcome for low-income countries but not for high-countries. Of the other variables, income is highly significant in both groups, as is education. The level of savings is significant in low-income countries but not in high-income countries. The final set of regressions (Models 9 and 10) present results for the case where health is proxied by infant mortality. Income level has a strong effect in both groups but income inequality is not significant. Savings has a strong effect in low-income countries but not in high-income countries. Finally, education has a strong effect on health in both groups.

The regression results obtained for life expectancy indicate that reducing income inequality has a greater effect in low-income countries than in high-income countries. This is consistent with diminishing returns to health with increase in income. Among high-income countries, there is less variation in income inequality compared to high-income countries. Thus, a reduction in income inequality is expected to have a lesser effect on health. The results also indicate that regardless of income level, education is a significant predictor of health. Finally, the level of savings is significant in low-income countries but not in high-income countries.

Policy Implications

In recent years improvement in health has been viewed as a necessary condition for economic development. Under the human capital view of health, improved health is seen as a factor for enhancing the production possibilities of the economy, which in turn enhances the income-earning potential of the population. Improved health reduces the depreciation rate of human capital, which makes investments in education more attractive, and thus enhances economic development. By increasing longevity, a healthy population limits the economic losses to society. It has also been suggested that improved health facilitates economic participation of women (Mayer, 2000).

Our empirical results indicate that in efforts to improve health, emphasis must not only be placed on improving health infrastructure and health systems, but also on broader issues such as improvement of income inequality. Our results indicate that the health benefits of improving income inequality are greater in developing countries. Policies for improving income inequality in such countries could include increasing the size of the safety net and instituting a system of childcare credits where these do not already exist. Institution of basic programs such as provision of clean water and sanitation, malaria eradication campaigns, and vaccination drives will help to improve the incomes of the poor relative to the rich and improve income inequality.

In addition to improving the distribution of income, there is the need for increased expenditure on education as it has been shown that this is a strong factor affecting health status. In many developing countries, social services such as health and education tend to suffer cuts during periods of economic rationalization or structural adjustment. However, these non-economic sectors have strong links to long-term economic development.

Therefore, there is an urgent need to increase (or at least maintain) expenditures in these sectors even in times of economic downturn.

Summary and Conclusions

This study has empirically examined the determinants of health status in general, and in particular, the effects of income inequality on health in order to suggest appropriate policy interventions. A model of health status was specified in which the main variables were income level, income inequality, the level of savings and the level of education. The model was estimated using a panel data set for 44 countries covering six time periods. The results indicate that income, inequality (measured by the Gini coefficient) and educational level are significant determinants of health status.

Previous studies (e.g. Deaton, 2001; Ross et al. 2000) have found no effect of income inequality on health. However their findings could be influenced by the fact that the samples used were homogenous. In this study, we employed a heterogeneous mix of countries from the lower, middle and upper income countries in a panel framework. Inequality, as measured by the Gini coefficient, has a significant effect on health status when we control for the levels of income, savings and education. The relationship is consistent regardless of the specification of health status and income. Thus, the study results provide some empirical support for the income inequality hypothesis.

The relationship between income inequality and health is complex and the pathways are poorly understood. Future work in this area requires experimentation with different measures of inequality in order to test the robustness of the relationship. There is also a need for further work to examine the effect of income inequality on health at a

disaggregated level – communities and individuals. This sort of work will help to clarify the mechanisms by which income inequality affects health for different segments of the population or different communities. Finally, there is the need for comparative country specific studies to further investigate the characteristics of societies in which income inequality is significant compared to those where inequality does not matter. Such studies will further enhance our understanding of the mechanisms of causation.

Notes

1. Costa Rica had a 1997 GDP per capita of US$3650 and life expectancy of 76.0 years, while Cuba had a 1997 GDP per capita of US$3100 and life expectancy of 75.7 years.
2. See Wagstaff and van Doorslaer (2000) for an extensive review.
3. The Robin Hood Index is defined as the maximum distance between the Lorenz curve and the diagonal. It is the share of income to be taken from those above the mean and given to those below the mean to achieve equality in income distribution (see Kondor, 1971).

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Appendix 1. Countries included in the sample

1. Argentina	23. Malaysia
2. Australia	24. Mexico
3. Austria	25. Morocco
4. Bangladesh	26. Netherlands
5. Belgium	27. New Zealand
6. Brazil	28. Nigeria
7. Canada	29. Norway
8. Chile	30. Pakistan
9. Columbia	31. Panama
10. Costa Rica	32. Peru
11. Cote d'Ivoire	33. Philippines
12. Denmark	34. Portugal
13. Egypt	35. Singapore
14. Finland	36. Spain
15. France	37. Sri Lanka
16. India	38. Sweden
17. Indonesia	39. Thailand
18. Israel	40. Tunisia
19. Italy	41. United States
20. Jamaica	42. Uruguay
21. Japan	43. Venezuela
22. Korean Republic	44. Zambia

Table 1. Summary statistics (means), 1970-1995

Variable	All countries	Advanced countries	Asia	Latin America /Caribbean	Africa
Life expectancy (years)	67.7	74.9	62.5	68.8	57.2
Infant mortality (per 1000 live births)	57.5	19.2	80.4	67.9	96.1
Gini coefficient	39.9	32.6	39.3	49.1	42.9
Per capita GDP (1995 US$)	9164.13	19187.57	2579.68	3329.08	4829.16
Human Dev Index	0.675	0.838	0.556	0.682	0.485
Educational Expenditure (% GDP)	3.9	4.9	2.5	3.4	4.3
Domestic savings (% GDP)	10.9	14.8	11.6	8.8	4.2
Primary school enrolment (‘000s)	6297	3352	14657	5017	3100

Table 2. Regression results with life expectancy as the dependent variable[a]

Variable	Model 1[b]	Model 2[c]	Model 3[d]
Constant	64.494 (41.26)	3.953 (25.650)	31.146 (19.807)
Y_{t-1}	0.0004** (7.963)	0.026** (2.456)	51.688** (8.509)
Q_{t-1}	-0.025 (-0.968)	-0.036** (-2.061)	0.022* (1.455)
SAV_{t-1}	0.026 (1.099)	0.006* (1.616)	0.003 (0.245)
ED_{t-1}	2.21×10^{-07}** (5.066)	0.025** (2.677)	4.91×10^{-08}** (2.000)
R^2	0.953	0.935	0.990
Adj. R^2	0.952	0.934	0.989
N	220	220	220

a. t-ratios are in parentheses.
b. Income variable is GDP level.
c. Income variable is education expenditure.
d. Income variable is HDI.
** Significant at the 5 percent level or better.
* Significant at the 10 percent level.

Table 3. Regression results with infant mortality as the dependent variable[a]

Variable	Model 4[b]	Model 5[b]	Model 6[c]
Constant	52.299 (4.802)	37.785 (3.113)	251.679 (21.150)
Y_{t-1}	-0.002** (-6.394)	-4.598** (-2.910)	-291.098** (-21.108)
Q_{t-1}	0.616** (2.920)	0.967** (4.626)	0.145* (1.292)
SAV_{t-1}	-0.050 (-0.261)	-0.200 (-1.008)	-0.056 (-0.541)
ED_{t-1}	-5.04×10^{-07}* (-1.801)	-6.10×10^{-07}* (-1.978)	-3.33×10^{-07}* (-1.773)
R^2	0.877	0.870	0.977
Adj. R^2	0.875	0.867	0.976
N	220	220	220

a. t-ratios are in parentheses.
b. Income variable is GDP level.
c. Income variable is education expenditure.
d. Income variable is HDI.
** Significant at the 5 percent level or better.
* Significant at the 10 percent level.

Table 4. Regression results for low and high income countries[a]

Variable	Model 7[b] (Low-income countries)	Model 8[b] (High-income countries)	Model 9[c] (Low-income countries)	Model 10[c] (High-income countries)
Constant	62.132 (18.161)	71.414 (54.196)	93.713 (5.190)	33.949 (5.144)
Y_{t-1}	0.003** (5.632)	0.0002** (8.790)	-0.010** (-3.506)	-0.001 (-8.686)
Q_{t-1}	-0.112* (-1.645)	-0.004 (-0.158)	0.219 (0.534)	0.159 (1.016)
SAV_{t-1}	0.130** (2.110)	-0.020 (-0.835)	-0.598 (-1.836)*	-0.078 (-0.648)
ED_{t-1}	-6.31×10^{-08} (-1.663)*	-4.76×10^{-08} (-1.247)*	4.43×10^{-07} (2.213)**	2.56×10^{-07} (1.341)
R^2	0.280	0.528	0.184	0.563
Adj. R^2	0.257	0.508	0.154	0.545
N	138	100	138	100

a. t-ratios are in parentheses.
b. Dependent variable is life expectancy; income variable is GDP level.
c. Dependent variable is infant mortality; income variable is GDP level.
** Significant at the 5 percent level or better.
* Significant at the 10 percent level.