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THERE'S MORE TO LIFE THAN MONEY: EXPLORING THE LEVELS/GROWTH PARADOX IN INCOME AND HEALTH[†]

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Abstract: This paper discusses historical and recent cross-country evidence relating income to measures of health. After a review of the literature on income and the quality of life, the paper looks at long-term historical evidence on the link between income change and health indicators. Using data on life expectancy, infant mortality and income for a small subset of largely wealthy countries over the 1913–1999 period, the paper examines correlations between income and health at period start and end as well as using the growth of the variables. Using a larger set of data over the period 1975–2000, the paper repeats these tests, as well as looking for any evidence of a larger impact of income, when different data are used or the sample is split. Results suggest a strong cross-country link between income and health and considerable evidence of global improvements over time, but a comparatively weak relationship between improvements in income and improvements in health, even over the very long term. The paper discusses a model based on technology and institutions that might account for such results as well as some preliminary evidence in favour of such a model. Copyright © 2008 John Wiley & Sons, Ltd.

Keywords: health; economic growth; mortality; education; institutions

1 INTRODUCTION

There are two views regarding the impact of income on health. The first view suggests that income is central to the process of the mortality transition (Pritchett and Summers, 1996; Fogel, 2004). Income provides resources for improved nutrition. At both the individual and national level, it improves access to health care services and public health measures including sanitation. Income also allows for access to knowledge and education that are

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vital to creating the demand for health services and the ability to reduce exposure to pathogens.[1]

The second view accepts that adequate nutrition, public health, knowledge and education are all vital to the mortality transition, but questions the central importance of greater income in achieving improvements in these areas (Hanmer *et al.*, 2003; Deaton, 2004). This view emphasises the role of interventions that are cheap or free (vaccines, breastfeeding, boiling water), backed by the rollout of institutions and educational systems that are only weakly connected to more rapid economic growth.

This paper reviews the literature and provides additional analysis to suggest that the evidence supports this second view over one that emphasises the centrality of income. The paper concludes that there is evidence for a link between income and health outcomes, but that different (very simple) cross-country regression approaches suggest that the link is partial and complex. The paper discusses evidence for the importance of cheap technologies in determining improvements in global health which helps to account for this weak relationship.

There are a number of countries that are comparatively rich and healthy today. By and large, they were comparatively rich and healthy in the past. However, more or less rapid income growth over time appears to be weakly correlated with rates of progress in health. This may suggest that a significant determinant of present-day health and income outcomes is some past and/or slow-changing factor that underlies progress in both. The paper examines institutional explanations for differing health outcomes and provides some suggestive evidence in support of such a model.

2 LITERATURE REVIEW

It is clear across countries at any one time that 'wealthier is healthier' (Pritchett and Summers, 1996). High-income countries see average life expectancies 20 years longer than low-income countries, and child mortality rates of 0.7 per cent compared to 12.3 per cent (World Bank, 2005). Given this, it is unsurprising that a range of cross-country regression analyses find income a significant correlate with health outcomes (including Filmer and Pritchett, 1999; Thorbecke and Charumilind, 2002; Wang, 2002; Leipziger *et al.*, 2003).

Nonetheless, the income–health relationship at a single time is far from straightforward. Across countries, Wagstaff (2001) notes that children living on a dollar a day face considerably different chances of dying around the world—a Kazakh child faces a 4 per cent risk of dying before their first birthday compared to a 16 per cent chance for a similarly poor child in Niger, for example. Long-term historical evidence similarly suggests the importance of factors weakly related, or unrelated, to income. Table 1 compares Vietnam in 2000 to the United Kingdom in the early 19th century. As can be seen, despite sharing similar incomes, the two countries are very different on a range of measures, including health outcomes, where Vietnam's life expectancy is 28 years longer than was the United Kingdom's in the early 1800s.

[1]An example of the income preeminence view is Ravallion (1997): 'let us agree that there are dimensions of welfare that cannot be easily aggregated with consumption of market goods—call them "non-income" dimensions. . .. In practice, there is considerable congruence between standard measures for these two dimensions of welfare. . .High correlations are observed in cross-country data between average incomes and human development indicators, and between their rates of change over time'.

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Table 1. Comparing modern Vietnam and 1800s Britain

Indicator	UK, early 19th century	Vietnam, 2000
Income per capita ($)	1700	1860
World richest country income ($)	1700	31 910
Share of income to top 10% of population (%)	49	30
Life expectancy (years)	41	69
Infant mortality (per 1000)	160	37
Literacy (%)	69	95
Electricity production (bn kwh)	0	22
Urbanisation (%)	39	20
Army (% population)	1.2	0.6
International telephone traffic (min/subscriber)	0	22
Voters (% eligible, choice)	10 (multiparty)	100 (party approved)
Trade % GDP (global)	2	27
International aircraft passengers (m)	0	3.0

Sources: Kenny (2005), World Bank (2005), Lindert (1986), Steckel (2001), Toyama (2004), Chesnais (1995), Taylor (2002).

Preston (1975) was the first to note that, over time, the life expectancy associated with a given level of income was rising rapidly. Preston argued that this global change was three to nine times more important in explaining growth in life expectancy than changes in income.

Indeed, perhaps particularly weak is the apparent link between *growth* in income and *improvements* in quality of life. While incomes have diverged worldwide, many other indicators of the quality of life are strongly converging. For example, average global life expectancy was 51 in 1950, with a standard deviation of 13 years. By 1999, life expectancy worldwide averaged 69 with a standard deviation of 7. There are a number of cases over the last 50 years where improvements in quality of life occurred in countries where there was zero or negative income growth (Kenny, 2005).[2] Almost all of China's post-war reduction in infant mortality happened prior to the acceleration in economic growth after 1980—and the period since then has seen relatively little progress (Cutler *et al*., 2006).[3] More broadly, Easterly (1999) could find very few health variables where the link between income and quality of life was positive and significant over the past 40 years (see also Szretzer, 1997; McGuire, 2001; Deaton, 2004).[4] Again, Younger (2001), looking at infant mortality, finds that regressions focusing on growth or using fixed effects find weaker relationships than those looking purely across countries. For example, he finds that greater income does correlate with declines in infant mortality, but this impact disappears if country-fixed

[2]Easterlin (2004) adds a number more from the early 20th century including Cuba, the Philippines and Sri Lanka.
[3]While Banister and Zhang (2005) suggest that their data and analysis show that '[e]conomic growth plays a key role in reducing mortality in China' in the 1980s and 1990s, the significance of income in their results does not survive the introduction of a time dummy. Similarly, Brainerd and Cutler (2005) in their examination of the 6.6 year decline in Russian life expectancy 1989–1994, found that alcohol and stress were the two most significant factors while the changing cost and quality of health care and greater material deprivation apparently played little role.
[4]As further support, Younger (2001) also finds that a number of variables commonly associated with income growth (black market premium, trade restrictions, M2/GDP, financial depth, inflation, a measure of inefficient taxation, a measure of competitiveness, secondary enrolment) appear insignificantly related to declines in infant mortality. Nonetheless, while the cross-country evidence is weak, it should be noted that other approaches do suggest that there can be a link (see, e.g. McGuire, 2001).

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effects are included in his regressions. (He finds the same result with primary education.) This paper further examines the income–quality of life relationship across countries and across time in the light of heterogeneous results to date.

3 LONG-TERM CROSS-COUNTRY EVIDENCE

How much over the long term have changes in income mattered either as a direct source of improvement in health variables, or acting indirectly through any impact on institutional and technical change? A first step in the analysis of the historical relationship between income and health is to look at the relationship across countries at different times and within countries across the period 1913–1999. Our chosen indicators for this part of the exploration are life expectancy and infant mortality (based on cross-country data availability). We have data for 27 countries for income and life expectancy and for 19 countries for infant mortality (data from Kenny, 2005).

Amongst this group of countries, the average income increased from \$3004 to \$15 237 over the 1913–1999 period, while life expectancy increased from 47 to 76 years and infant mortality declined by over 90 per cent. As can be seen from Table 2, there was also an increase in the strength of the cross-country relationship between income and health outcomes, with the R^2 of the relationship between income and life expectancy increasing from 0.62 in 1913 to 0.89 in 1999, for example.

However, if we simply examine the correlation between income growth and life expectancy growth, the coefficient is in fact negative, and less than 1 per cent of the change in life expectancies across countries can be predicted based on income change. This is a finding reasonably robust to data quality issues given the fivefold increase in average incomes that occurred over the period, the 69 per cent average increase in life expectancy, and the considerable standard deviation in outcomes (268 per cent for income and 36 per cent for life expectancy).

Table 2. The long-term relationship between income growth and health improvements

Indicator	Regression	Independent variable		Dependent variable		Regression results		R^2
		Average	Standard deviation	Average	Standard deviation	C	Variable	
Life expectancy	1913	7.88	0.56	46.5	9.87	-63.8^{*}	14.0^{*}	0.62
	1999	9.47	0.67	75.5	4.45	16.6^{*}	6.21^{*}	0.89
	Growth	5.38	2.68	1.69	0.36	1.78^{*}	−0.02	0.01
	Residual correlation	0.00	6.06	0.00	1.50	0.00	−0.02	0.00
	1913 residual to growth	0.00	6.06	1.69	0.36	1.69^{*}	-0.04^{*}	0.40
Infant mortality	1913	7.94	0.52	132	63.2	633^{*}	-63.1^{**}	0.27
	1999	9.45	0.70	10.4	15.1	180^{*}	-17.9^{*}	0.69
	Growth	4.95	2.08	0.07	0.07	0.15^{*}	-0.02^{***}	0.19
	Residual correlation	−0.00	54.0	−0.54	8.4	−0.54	−0.05	0.12
	1913 residual to growth	−0.00	54.0	0.07	0.07	0.07^{*}	−0.00	0.04

Notes: *Significant at 1 per cent; **significant at 5 per cent; ***significant at 10 per cent. Sample size: 27 countries for life expectancy, 19 for infant mortality. Data are in logs for cross-country, 1999/1913 for growth.

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It should be noted that it does not appear that amongst this sample some countries are permanently disadvantaged in terms of seeing lower life expectancy for a given income—there is very little correlation between the residual of the 1913 cross-country regression and the residual of the 1999 regression, and the coefficient is in fact negative. Nonetheless, countries doing worse than expected in terms of life expectancy at a given income in 1913 did see slightly slower growth in life expectancy 1913–1999. We will also see evidence later in the paper that there is persistence in low life expectancy itself over the long term amongst this group of countries.

The results are broadly similar for infant mortality, although the relationship between income growth and infant mortality decline is slightly stronger and there is some more evidence of fixed effects. In other words, while rich countries are healthier, countries which grow faster do not become healthier faster.

4 MORE RECENT EVIDENCE

The general results suggested in this section can be illustrated using the world's four largest developing countries as examples—China, India, Indonesia and Brazil. Table 3 shows that China approximately quintupled its income 1980–2000, by far the best performance in terms of economic growth. At the same time, however, it saw by far the lowest growth rate in terms of life expectancy. Conversely, Brazil, where there was almost no economic advance at all over the same period, still managed to increase life expectancy by 11 per cent.

Using data for the period 1975–2000, we can expand country coverage and variable inclusion for cross-country analysis (Table 4). Our chosen cross-country indicators for dependent variables in this part of the exploration are male and female life expectancy at birth, infant and under-five mortality. Income is measured in constant purchasing power parity GDP per capita. All data are from World Bank (2005). The dataset covers all countries for which data are available (i.e. from low to high income).

As with the long-term analysis presented above, at any one time, income correlates with a good deal of the cross-country variation in our chosen variables. In 2000, variation in log income correlates with over 70 per cent of the variation in global life expectancies, infant

Table 3. Country examples of the link between income growth and health improvement

	1980	2000	% Change
China			
GDP per capita, PPP	763	3928	415
Life expectancy	67	70	4
Brazil			
GDP per capita, PPP	6890	7301	6
Life expectancy	63	70	11
India			
GDP per capita, PPP	1178	2415	105
Life expectancy	54	63	17
Indonesia			
GDP per capita, PPP	1462	3028	107
Life expectancy	55	66	20

Source: World Bank (2005).

Table 4. The short-term relationship between income growth and health improvements

Indicator	Regression	Independent variable		Dependent variable		Regression results		
		Average	Standard deviation	Average	Standard deviation	C	Variable	R^2
Male life exp ($N = 100$)	1975	8.23	1.06	58.1	10.7	−9.44**	8.21*	0.67
	2000	8.55	1.25	63.9	12.2	−7.50**	8.36*	0.73
	Growth	1.57	0.93	1.10	0.10	1.11*	−0.003	0.00
Female life exp ($N = 100$)	1975	8.23	1.06	62.4	11.9	−16.1*	9.54*	0.72
	2000	8.55	1.25	68.2	13.8	−12.9*	9.49*	0.74
	Growth	1.57	0.93	1.10	0.12	1.09*	0.002	0.00
Infant mortality ($N = 102$)	1975	8.22	1.05	71.6	50.7	391*	−38.8*	0.65
	2000	8.54	1.24	41.3	41.8	298*	−30.1*	0.79
	Growth	1.58	0.92	0.48	0.23	0.60*	−0.07*	0.10
Under-five mortality ($N = 98$)	1975	8.24	1.05	108	84.6	638*	−64.2*	0.63
	2000	8.56	1.22	60.1	68.6	472*	−48.1*	0.73
	Growth	1.57	0.92	0.46	0.23	0.59*	−0.08*	0.11
Gross primary ($N = 86$)	1975	8.25	1.06	89.2	25.3	−7.38	11.7*	0.24
	2000	8.58	1.21	101	16.0	54.1*	5.43*	0.17
	Growth	1.56	0.90	1.23	0.42	1.38*	−0.09**	0.04
Gross Secondary ($N = 69$)	1975	8.43	1.00	47.7	28.3	−141*	22.4*	0.63
	2000	8.85	1.07	79.1	34.1	−163*	27.4*	0.75
	Growth	1.69	0.94	2.88	7.05	3.28**	−0.24	0.00

Notes: Data are in logs for cross-country, 2000/1975 for growth.
*Significant at 1 percent; **significant at 5 percent;

and under-five mortalities, for example. Furthermore, this cross-country relationship is getting stronger over time, with the percentage of variation in health correlated with variation in income rising 6 percentage points for male life expectancy and 14 points for infant mortality between 1975 and 2000.

Again, however, and despite the strengthening cross-country relationship between health and income visible in ‘snapshot’ pictures from 1975 to 2000, income growth over that 25 year period tells us very little about the speed of life expectancy improvement. Growth in income performs somewhat better in the case of infant and under-five mortality, although still only able to explain 11 per cent of the variation in outcomes. This is all despite the fact that the average country in our sample has increased its income per capita over 58 per cent during that period, with a standard deviation of 92 per cent, while infant mortalities fell on average over 50 per cent with a standard deviation of 23 per cent.

5 ISSUES WITH TECHNIQUE AND DATA QUALITY

Perhaps there are significant lagged effects. Lindeboom *et al.*’s (2003) study of life expectancy between 1812 and 1999 in the Netherlands suggests that GDP per capita prevalent at birth and early childhood has a considerably more significant impact on life expectancy than changes in instantaneous income, suggesting the potential for

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considerable lagged effects of GDP/capita change. It would be hoped, however, that even lagged effects would be picked up at least in the 1913–1999 growth analysis.

Might it be that the impact of income is obscured by the low quality of data? Might random error in both income and quality of life variables be decreasing over time, strengthening cross-country relationships while producing little but noise in growth relationships? Data issues are certainly significant, in particular for our estimates for 1913. Some infant mortality data include interpolations, for example (Younger, 2001).[5] Furthermore, sources of error overlap between health variables as infant mortality is used to estimate under-five mortality and *vice versa* while both are used to estimate life expectancy (McGuire, 2005). Official and survey-based estimates of infant mortality in Kazakhstan, Azerbaijan, Uzbekistan, Armenia, Albania and Georgia vary by two to four times, based in part on under-reporting, miss-reporting and misclassification. Even survey-based evidence itself is far from foolproof, with techniques used that are quite likely to be subject to reporting and classification errors. Purely statistical sources of error provide a 95 per cent confidence interval of 52.3–69.3 per thousand births for recent Kenyan infant mortality, for example (Aleshina and Redmond, 2003).

The infant and child mortality trends used by this paper for 1975–2000 derive from Hill *et al*. (1998), which in turn are based on weighted (by perceived accuracy) data largely from household surveys and censuses. There are significant concerns about data quality, especially in poorer countries with small-sample or infrequent household survey evidence. The estimation approach fits a trendline to the available data using weighted least squares, with breaks in the trendline determined by accumulation of sufficient data. In (largely poor) countries with less data, there will be fewer breaks in the trend. The resulting estimates have to be treated with caution.[6]

Cooper (2005) points out that there are also significant margins both of error and interpretation even for GDP PPP. Combining weak underlying GDP data with weak price data and somewhat arbitrary decisions on weighting prices allows for some significant variation between ‘real’ and reported income, for example. Using Chinese expenditure weights, the country’s per capita income at US prices in 1986 was \$571, while using US weights it was \$1818 (see also Neary, 2004).

However, with analyses covering periods as long as 25 and 87 years, it would be hoped that the impact of poor data producing fuzzy estimates would be minimised, as noted above. Korenromp *et al*. (2004) suggest that, based on the quality of Demographic and Household Surveys (DHS) in Africa, reductions in under-five mortality rates of greater than 15 per cent should be reliably detected by the data. Over a 4–7 years period between the two first DHS surveys in those countries, five out of the seven African nations studied by Korenromp *et al*. (2004) saw infant mortality drops large enough to be very confident of their statistical significance ($p < 0.001$). This suggests that, relying on even long-term data, fears that patterns are being lost in the noise should be reduced (even though the quality of the data of earlier estimates is likely to be lower). While growth regressions attenuate

[5]Although that would expect this to strengthen the relationship with at least the variables used to project the data.
[6]For Hill *et al*. infant mortality (or under-five mortality) is derived from life tables and the value of under-five mortality (or infant mortality) where data are unavailable. It is also worth noting that Hill *et al*. use their underlying U5M data to look at the relationship between U5M and income only in cases where they have a reliable underlying datapoint for U5M (i.e. their estimate is not based on a modelled result). Using just one period dummy (pre- and post-1980) and region dummies for South Asia and Sub-Saharan Africa, they do find that GDP per capita change is statistically significantly related to U5M change.

DOI: 10.1002/jid

results compared to cross-country studies, we have seen the significant changes—and, as important, the significant variation in changes—that have occurred over those periods.

Furthermore, there are significant correlations between growth in potential non-income determinants (such as female literacy) and growth in health indicators.[7] This suggests that the data are not so weak that they are unable to illuminate correlational relationships where such relations are strong and present. In particular, it should be noted that whatever the weaknesses in data governing mortality, it is strong enough to show significant declines over time. Given one might expect, as underreporting was reduced with the spread of household surveys, reported rates of mortality to *rise*, a significant decline appearing in the data is surely a sign that considerable declines have occurred. We cannot see that same significance in terms of the relationship between income changes and health changes, suggesting that, however much the statistical significance of the income coefficient is weakened by data quality, it does not start off as strong as a time coefficient in a panel data regression or a constant coefficient in a growth regression.

Again, results do not significantly change restricting our analysis to high-quality data. We have data from World Bank (2006) on infant mortality for girls and boys based only on survey data over time 1986–2001 for 34 countries with two surveys (Table 5). Using these data, we can see if there is a stronger relationship between income and infant mortality in countries with quality data, and using only a developing country dataset (starting incomes per capita vary between PPP$436 and $6469). Our variables are the percentage change in income between the two surveys, the percentage change in infant mortality and the number of years between first and last surveys. As can be seen in Table 5, income change is somewhat significantly related to declining male and female infant mortality when entered with a constant alone. Adding a time dummy weakens the significance of income (it is also worth noting the very low R^2, once more suggesting much else is going on beside).

Might the impact of income on health be different with different measures of health? All of our indicators are strongly influenced by health outcomes affecting very young children[8]—perhaps results would be different for an older sample? We have data on female and male adult mortality (measured as the chance of a 15 year old dying before the age of 45, noted as 45q15) in developing countries from Hill and Choi (2004). When purged of data that the authors consider moderate or poor, and limited to countries where we have two or more observations, we are left of a dataset covering 50 datapoints in 14 economies over the period 1957–1998.[9] This we combine with purchasing power parity GDP per capita data from Summers *et al*. (2002). Using country-fixed effects, we measure the impact of income (log GDP per capita) and time (measured as the number of years since 1950) on male and female life expectancy (Table 6).

At the 10 per cent level of significance, income is significantly related to female adult mortality. Taking the resulting coefficient at face value, it is worth considering the relative importance of time and income (although it is worth noting that this is likely to underestimate the true correlation between income and health).[10] South Korea was one of

[7]Regressions reported in draft version of the paper are available on request.
[8]Indeed, in a considerable proportion of developing countries, life expectancy is estimated from under-five mortality rates, as we have seen (McGuire, 2005).
[9]The economies are Egypt, China, South Korea, Taiwan, Thailand, Argentina, Brazil, Chile, Colombia, Dominican Republic, Guatemala, Mexico, Panama and Puerto Rico.
[10]Random measurement error in the explanatory variable in a regression will lead to underestimation of the coefficient on that variable, and this problem is magnified when looking at changes in variables over time (which reduces the 'signal to noise' ratio).

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Table 5. The relationship between changes in income and infant mortality using survey data

	Female infant mortality		Male infant mortality	
Intercept	−0.10**	0.10	−0.09**	0.15
Income % change	−0.37**	−0.28***	−0.39**	−0.29**
Year change		−0.02**		−0.03*
Adjusted R^2	0.11	0.21	0.12	0.29
N	34	34	34	34

Note: Averages (standard deviations) for the variables are as follows: male infant mortality change −0.13 (0.21); female infant mortality change −0.14 (0.21); income change 0.11 (0.21); year change 8.4 (3.1).
*Significant at 1 percent; **significant at 5 percent; ***significant at 10 percent.

Table 6. Adult mortality 15–45, levels regressions on an unbalanced panel

	Female 45q15	Male 45q15
Intercept	0.51*	0.44
Ln GDPPC	−0.033***	−0.018
Year 1950	−0.0028*	−0.0029**
Adjusted R^2	0.76	0.63
Observations	50	50

Note: Averages (standard deviations) for the variables are as follows: GDPPC 5221 (3117); year 1980 (11.29); male 45q15 0.246 (0.072); female 45q15 0.155 (0.061).
*Significant at 1 percent; **significant at 5 percent; ***significant at 10 percent.

the very fastest growing countries between the first and last observation we have for female adult mortality, with GDP per capita rising from $1911 to $13 463 (1958–1998). Over that period, the 45q15 for females fell from 0.3 to 0.07 (or from a 30 per cent chance of dying to a 7 per cent chance). South Korea's astronomical income growth correlated with as little as 7 percentage points of that change, while the passage of time (measuring global technological progress) accounted for 11 per cent, leaving other factors accounting for 5 per cent. For the average country, the passage of time will be the far more important factor in explaining progress. For Brazil between 1965 and 1996, for example the model predicts a 3 per cent of change due to income growth (or correlated factors) compared to a 9 per cent change due to the passage of time.

For male adult mortality, the picture is even less clear. Income per capita does not enter with any significance (and a coefficient one half the size), whilst the time variable enters with strong significance and a very similar coefficient to that seen for female mortality.[11]

Is the weak overall correlation between income and health due to model mis-specification? One immediate cause of mis-specification may be the fact that our dependent

[11]These results may help to explain the weaker relationship between life expectancy and income than between child and infant mortality and income. There may also be a considerable lag between income effects and changes in adult mortality levels, as we have seen. It is worth noting in addition the smaller overall variation in life expectancy outcomes than infant mortality outcomes (the coefficient on 2000 life expectancy in the global sample is 0.19, compared to 1.02 for infant mortality), so that a similar percentage error in life expectancy measures will translate into greater difficulty in uncovering a statistically significant correlation with income than in the case of infant mortality. At the same time, this cannot account for the wrong sign of the income coefficient in a number of the life expectancy regressions.

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variables have 'natural limits'—life expectancy may not reach above a certain level whatever the income increase (although it does keep rising in rich countries), and under-five and infant mortality are bounded at zero. There is also evidence of convergence in health across countries (Kenny, 2005), perhaps based in part on a logistic-curve model of improvement (Clemens, 2004).

Related to this, it may be, as argued by Ingram (1994), that the relationship between income and quality of life is extremely nonlinear. It is increasingly accepted that the link between income growth and health improvements in rich countries is weak. Deaton and Paxson (2004) look at age-specific mortality in the UK and US since 1950 and conclude that neither average income nor changes in income distribution can help to explain the observed trends. There are concerns with health that, above a certain level, the private returns to greater income may even turn negative thanks to excessive consumption (see Frech and Miller, 1996 for a partial review). However, if this were driving the weak relationship with income growth, given growing global income, one would expect the cross-country link between income and broader quality of life to weaken over time—and this is not the case.

Regardless, as a robustness check, it may be worth examining a low-income country sample to see if results are stronger. The high-quality infant and adult datasets used earlier were restricted to developing countries and did not uncover a strengthened relationship, but this was with smaller samples. Table 7 reports on regressions involving a subset of countries from the full dataset—those with GDP PPP in 1975 below \$3000 (approximately the current cut off for lower middle-income country status). The constant in every case suggests that low-income countries have partaken of the global progress in quality of life. Regarding the correlation between income and quality of life, declines in infant and under-five mortality again appear to be significantly linked to increases in income. Again, however, changes in life expectancies appear insignificantly related to income change, and the strongest R^2 of any of the relationships is only 0.17, in the case of under-five mortality—even in this best case 83 per cent of the variation in reported under-five mortality decline in countries with GDPs under \$3000 over the 1975–2000 period is unconnected with reported variation in GDP per capita growth over that time (although note once again that higher quality data would be likely to produce a higher R^2).

As an alternate approach, Table 8 reports on regressions of growth of our dependent variables 1975–2000 against initial (1975) values of those variables and income growth. As can be seen, this does not appear to strengthen the relationship between income growth and quality of life growth, with income entering insignificantly in every regression but under-five mortality. There appears to be no strong relationship between overall life expectancy changes and initial life expectancy, and some evidence of divergence in infant

Table 7. Growth regressions on <\$3000 sample

	C	Income growth	RSQ	*N*
Female life expectancy	1.07*	0.01	0.01	41
Male life expectancy	1.10*	0.00	0.00	41
Infant mortality	0.76*	−0.07**	0.10	42
Under-five mortality	0.76*	−0.09*	0.17	40
Primary enrolment	1.62*	−0.10	0.06	34
Secondary enrolment	2.69*	−0.05	0.00	21

Note: *Significant at 1 percent; **significant at 5 percent.

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Table 8. Health growth regressions with initial values of dependent variable

	C	Initial value	Income growth	RSQ	*N*
Female life expectancy	1.15*	−0.001	0.008	0.01	100
Male life expectancy	1.16*	−0.001	0.002	0.09	100
Infant mortality	0.33*	0.003*	−0.022	0.36	102
Under-five mortality	0.39*	0.001	−0.039***	0.29	98
Primary enrolment	2.54*	−0.015*	0.013	0.80	86
Secondary enrolment	6.22*	−0.074	0.111	0.09	69

Note: *Significant at 1 percent; ***significant at 10 percent.

and under-five mortality.[12] In short, it does not appear that the exclusion of initial values of the dependent variable account for the weak income growth–quality of life growth relationship.

Perhaps missing causal variables beyond income and initial values of the dependent variable account for the weak results. Relationships between income and broader quality of life may be context dependent. For example, Ersado (2005) finds that small-scale irrigation dams in Ethiopia improve agricultural yield and farm profits at the same time as they have considerably increased the burden of disease. Once again, however, we might expect nonlinearities and complex relationships to weaken cross-country single-time correlations as well as growth relations—and yet single-time correlations are gaining in strength.[13]

It is worth noting here that we have considered the causal relationship between income and health that runs solely in one direction. Yet there is a considerable literature linking improved health causally with economic growth. Weil (2005) reviews numerous studies suggesting that adequate nutrition and good health are strongly associated with subsequent productivity and income at both the individual and national level and provides his own estimates that health can account for between 10 and 23 per cent of the global variation in GDP per worker (see also Strauss and Thomas, 1998; Wagstaff, 2005; Cutler *et al*., 2006). This suggests that some of the limited evidence we see for a link between income and health may be driven by reverse causality. Furthermore—and a subject discussed at greater length in a subsequent section—there could be underlying causal factors behind both health and income. Both of these factors suggest that the causal impact of income on health may be (even) lower than the analysis so far suggests.

6 IF NOT (PRIMARILY) INCOME, THEN WHAT?

There has been a dramatic, widespread increase in the quality of health outcomes worldwide. At the same time, the weak relationship of income to health appears to be robust to choice of health variables, data quality concerns, lagged impacts, context specifity or

[12]This finding would be reversed if our chosen measures were infant and under-five survival, see Kenny (2005).

[13]How do we reconcile the health results with Pritchett and Summers' (1996) paper 'Wealthier is Healthier'? First, the results are not in fact that different. Pritchett and Summers conclude that 'income changes explain less about mortality changes than economists might have supposed'. They, too, find no statistically significant relationship between income growth and life expectancy growth, stronger results with infant and under-five mortality but, even there, the strongest R^2 they record is 0.18 with infant mortality. Second, to explain remaining differences, they use a different technique (log levels with fixed effects) and a different dataset (countries under $6000 from 1960 to 1985).

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nonlinearities. Whilst the above analysis cannot rule out that relationships would be somewhat stronger with better quality data, and that at certain incomes or in certain environments the impact of income on health is larger, it is perhaps safe to say that the results suggest is not the dominant force behind changes in global health. This begs the question, if not income, then what?

The modern cross-country literature has found a range of potential significant determinants of health including time (Easterly, 1999; Clemens *et al.*, 2004), the broad policy and institutional environment (World Bank, 2003), immunisation rates (Younger, 2001; Wang, 2002; Hanmer *et al.*, 2003), female literacy and/or secondary education (Filmer and Pritchett, 1999; Ranis and Stewart, 2001; Leipziger *et al.*, 2003), access to potable water and/or sanitation (Hertz *et al.*, 1994; Wang, 2002; Leipziger *et al.*, 2003), broad pro-investment policies (Moore *et al.*, 1999), urbanisation (Moore *et al.*, 1999), inequality (Filmer and Pritchett, 1999; Thorbecke and Charumilind, 2002; Hanmer *et al.*, 2003—although see Deaton, 2004), doctors per capita (Hanmer *et al.*, 2003), the predominant religion (Filmer and Pritchett, 1999), ethnolinguistic fractionalisation (Filmer and Pritchett, 1999; Leipziger *et al.*, 2003), access to electricity (Wang, 2002), health expenditure (Wang, 2002) and measures of rights (Lena and London, 1993).

Most of these results are fragile. Younger (2001) notes that only two of his chosen policy variables (primary enrolment and DPT vaccination) show a consistent correlation across different samples and conditioning sets and even those correlations are not robust to the inclusion of fixed effects.[14] Nonetheless, factors related to the spread and acceptance of medical technologies as well as institutional strength appear to be two particularly significant determinants. This fits with our comparison of Vietnam today with the UK in the early 1800s. One thing that is immediately clear from Table 1 is that not only were people in the UK in the past poorer in that they could afford fewer things, but also their choice of things to buy was also far smaller. For example, the British subject in 1815 knew nothing of the germ theory of disease, little of inoculation and could rarely refrigerate foods.

The rapid spread of health and sanitation technologies even in the poorest countries will be a powerful force behind global convergence in life expectancies. Comin *et al.* (2006) find evidence of fairly rapid convergence across a range of health technologies (if from a widely dispersed starting point). Over recent history, there has been considerable convergence in the number of hospital beds per capita, the percentage of children immunised for DPT and the percentage of children immunised for measles.

What is notable about the most effective of health technologies is how cheap they are. Laxminarayan *et al.* (2006) rate the three most cost-effective interventions in Sub-Saharan Africa to reduce mortality and morbidity as childhood immunisation, interventions to reduce traffic accidents and the combination of bed nets, spraying and preventative anti-malarial treatment during pregnancy. At the low end, such interventions cost as little as $1–2 per disability-adjusted life year saved. Overall, a recent survey found that the cost of a basic (contracted-out) package of primary health services in rural areas ranged from US $2.82 per head per year in Cambodia to US $6.25 per head per year in Guatemala. In all cases studied, the amounts represent less than 1 per cent of Gross National Income (Loevinsohn and Harding, 2005).

Not only do these numbers suggest how inexpensive effective interventions can be, but also that interventions do not need to involve hospitals or doctors. For example, Malaysia and Sri Lanka have both made competent, professional midwives available in rural areas as

[14]Wang (2002), looking at rural determinants in particular, can also find no robustly significant determinants.

DOI: 10.1002/jid

well as ensuring access to drugs and equipment. Maternal deaths per 100 000 live birth have dropped from 2136 in 1930 to 24 in 1996 in Sri Lanka and from 1085 in 1933 to 19 in 1997 in Malaysia partially as a result (the estimate for the US is 17 per 100 000). Expenditure on maternal and child health services in the two countries is below 0.4 per cent of GDP, and a number of countries with similar incomes and higher health expenditures see higher maternal mortality ratios (World Bank, 2006).[15]

Basic education is another factor that appears to be strongly (bi-causally) related to health, probably because it is a factor in determining the rate of uptake of health technologies.[16] But recent educational performance is also weakly related to income, again probably because affordability of provision is not the major barrier to expansion even in the poorest countries. Tables 4, 7 and 8 include two educational variables (gross primary and secondary enrolment) and tend to repeat the findings reported earlier for health. Income growth is insignificantly (sometimes negatively) related to growth in enrolments. The problem with most really cost-effective measures regarding health is not that they are expensive but that they are related to knowledge flows and the need to create demand for health services particularly on the part of parents. As with education, the supply side of the health equation may be comparatively simple, with the demand side a complex process of creating the correct social environment (Clemens, 2004).

7 HEALTH AND INSTITUTIONS

Clemens (2004) and Clemens *et al*. (2004) note that much of the change over time in both health and education indicators can be described by their initial position on an s-curve of progress based on global historical performance. The results reported above fit with such a model. Perhaps some historical factor such as geographic influences on the form of colonial institutions explains when countries started their progression along the health s-curve and also determined an early start in sustained economic growth that leaves them richer than average today. In this case, there would remain a strong link between levels of income and levels of health (and education) but no necessary significant link between growth of the two variables or subsequent levels of institutional quality—the result that we have seen above.

The two most prominent versions of the environment to institutions to development story are Acemoglu *et al*. (2001) and Engerman and Sokoloff (2005). Both differ in emphasis in their focus on particular initial conditions but both conclude similarly that these conditions created highly unequal institutional structures ill-suited to fostering economic growth. In both models, the result of either disease, climate and/or soil quality was that areas suitable for plantations and ill-suited to European life developed extreme inequality, with a small elite of European descent controlling land and native labour, limiting opportunities for widespread accumulation of physical and human capital. Elites

[15]This might explain why it is so difficult to pick up the impact of health care spending on health outcomes, even in poor countries. McGuire (2005) repeats the common finding that health care expenditure (as well as geographic access to health services and per capita availability of doctors, nurses and hospital beds) is not associated with lower under-five mortality. But McGuire does find that maternal and infant health program effort and the share of births attended by trained personnel are correlated with improved outcomes. In turn, this links to literature suggesting that health expenditure may in fact improve outcomes in the presence of strong institutions (Baldacci et al., 2004; Gomanee et al., 2005).

[16]The relationship from health to education may be stronger than that from education to health, and there are likely to be causal relationships running in both directions with income (Baldacci et al., 2004; Sab and Smith, 2001).

DOI: 10.1002/jid

had little or no incentive to expand infrastructure beyond that required for extraction, a positive disincentive to expand educational opportunities, and no intent to expand suffrage in a manner that might have created political pressures for such activities. As a result, according to Engerman and Sokoloff, 'expenditures on education and other public services tended to be miniscule, reflecting (and contributing to) the magnitude of the inequality that existed between those of European descent and others'. Around 1870, the percentage of the population over the age of seven who were literate was about 24 per cent in Argentina, 16 per cent in Brazil, about 22 per cent in Chile and 16 per cent in Jamaica compared to over 80 per cent in the US. In the early 1900s, about 75 per cent of adult males in rural areas owned land in the US, as compared to about 2.4 per cent in Mexico.[17]

This interpretation of colonial history might help to explain long-term health and educational outcomes. Indeed, Acemoglu *et al*. (2001) themselves note that historical mortality figures for European settlers correlate with mortality rates today. Disease-rich environments will have a direct effect on life expectancy (42 per cent of lost disability-adjusted life years in Sub-Saharan Africa are still caused by infectious and parasitic diseases, as compared to 2.8 per cent in Western Europe—Bloom and Sachs, 1998), but perhaps even more importantly, the disease impact which shaped the form of colonial institutions limited effort to improve welfare outcomes for the majority. Given that we know that increasing educational enrolments is a long-term project with an upper-bound in terms of the speed with which it can be accomplished (Clemens, 2004), a far slower start in spreading education (usually begun at independence) will be a major force behind lower levels today. Furthermore, both a slower spread of education and more limited infrastructure rollout will be an important factor in explaining why some countries began the post-war race to improved health at a lower starting point.

Some further evidence for the thesis that long-term factors perhaps connected with colonial outcomes play a role in determining today's health and educational outcomes is that a regression of 1999 life expectancy on 1913 life expectancy using the earlier sample has an R^2 of 0.52, suggesting that relatively healthy countries yesterday are by and large healthy countries today. Furthermore, using a smaller sample of countries, we can predict 64 per cent of the variation in 2000 male life expectancy using data on ethnic fragmentation collected in the 1960s (and reflecting far older institutional structures) and data on 1910 primary school enrolment levels.[18] For a larger number of countries, we can predict 70 per cent of the variation in 2000 male life expectancy using data on ethnic fragmentation and the log of mortality rates amongst early colonists from Acemoglu *et al*. (2001).[19]

At the same time, as is clear from the high significance of the constant in almost every growth regression reported in Table 4,[20] global factors clearly have a very important role to play in explaining worldwide improvements in health and education (as suggested by

[17]Local governments in North America accounted for about 50 per cent of government revenues as compared to 10 per cent in South America in the 19th century. As these were the governments that were responsible in the main for schooling and infrastructure, and they were reliant on property taxes rather than tariff revenues, they were a considerable force for equality—a force largely absent in South America (Engerman and Sokoloff, 2005).

[18]Using life expectancy data from the dataset used in the rest of the paper, ethnic fragmentation data from Easterly and Levine (1997) and data on 1910 primary school enrolment as a percentage of the population from Easterlin (2004) for 17 countries. Both variables and the constant enter significantly at 5 per cent and with the expected sign, the adjusted R^2 is 0.64.

[19]Using life expectancy data from the dataset used in the rest of the paper, ethnic fragmentation data from Easterly and Levine (1997) and data on log colonist mortality from Acemoglu *et al*. for 54 countries. Both variables and the constant enter significantly at 1 per cent and with the expected sign, the adjusted R^2 is 0.70.

[20]As the variable of interest is end divided by start data, the significant difference of interest is difference from one, not zero—this is the case at 5 per cent significance for all health variables.

DOI: 10.1002/jid

Deaton, 2004 amongst others). The mortality and education revolutions have been far more widespread than the industrial revolution, displaying the rapid global growth and convergence which have been the unfulfilled promise of early income growth models.

It should be noted, however, that the evidence of institutional factors driving the starting point of progress and technology driving change over the long term is matched by evidence of significant volatility in health outcomes over shorter periods. There is very little relationship between life expectancy growth in period one and life expectancy growth during period two. The R^2 of a regression linking life expectancy growth worldwide 1962–1982 to life expectancy growth 1982–2002 is just 0.015.[21] Once the starting point of progress has been set and the influence of global technological change is accounted for, shocks may account for the majority of change in health outcomes over the shorter term that can be explained in a cross-country framework.

8 CONCLUSION

It is important to emphasise the significant global progress we have seen in broader measures of the quality of life over the 1975–2000 period. The coefficient of variation of GDP growth is 1.59, compared to 1.31 for female life expectancy, 1.12 for male life expectancy, 0.43 for infant mortality and just 0.41 for under-five mortality, suggesting rapid and more evenly spread progress in quality of life measures than in income. Nearly all countries nearly all of the time appear to be following a path towards longevity (although there is evidence that this progress is slowing, not least because of the AIDS crisis, see Kenny, 2005). Where countries find themselves along that path may be largely determined by a starting date perhaps in turn linked to the point at which institutions were put in place that allowed for medical and social advance and coincidentally allowed for sustained economic growth. As suggested by Jamison (2006): 'improvement in average income and education levels contributed to... worldwide gains in health. Much more significant, however, have been the generation and diffusion of new knowledge and of low-cost, appropriate technologies'.

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REFERENCES

Acemoglu D, Johnson S, Robinson J. 2001. The colonial origins of comparative development: an empirical investigation. *The American Economic Review* **91**: 1369–1401.

Aleshina N, Redmond G. 2003. How high is infant mortality in Central and Eastern Europe and the CIS? Innocenti Working Papers 95, Florence, Italy.

[21]The regression equation is Growth 82–02 = 0.1457(Growth 62–82) + 2.8997, $N = 161$, data from World Bank (2005).

DOI: 10.1002/jid

Baldacci E, Clements BJ, Gupta S, Cui Q. 2004. Social spending, human capital, and growth in developing countries: implications for achieving the MDGs. IMF Working Paper 04/217.

Banister J, Zhang X. 2005. China, economic development and mortality decline. *World Development* **33**(1): 21–41.

Bloom D, Sachs J. 1998. Geography, demography and economic growth in Africa. HIID, Mimeo, Harvard.

Brainerd E, Cutler DM. 2005. Autopsy on an empire: understanding mortality in Russia and the former Soviet Union. *CEPR Discussion Papers*. Discussion Paper, No. 4900. Centre for Economic Policy Research: London.

Chesnais J. 1995. Worldwide historical trends in murder and suicide. In *The State of Humanity*, Simon J (ed.). Blackwell: Cambridge, US, pp. 91–97.

Clemens M, Kenny C, Moss T. 2004. The trouble with the MDGs: confronting expectations of aid and development success. Center for Global Development Working Paper 40.

Clemens M. 2004. The long walk to school: international education goals in historical perspective. Center for Global Development Working Paper 37.

Comin D, Hobijn B, Rovito E. 2006. Five facts you need to know about technology diffusion. NBER Working Paper 1 1928.

Cooper R. 2005. A half-century of development. Harvard CID Working Paper 118.

Cutler D, Deaton A, Lleras-Muney A. 2006. The determinants of mortality. NBER Working Paper 1 1963.

Deaton A. 2004. Health in an age of globalization. *Brookings Trade Forum 2004*. Brookings Institution Press: Washington DC, pp. 83–130.

Deaton A, Paxson C. 2004. Mortality, income and income inequality over time in Britain and the United States. In *Perspectives on the Economics of Aging*, Wise D (ed.). University of Chicago Press: Chicago; 247–280.

Easterlin R. 2004. *The Reluctant Economist*. Cambridge University Press: Cambridge.

Easterly W. 1999. Life during growth. *Journal of Economic Growth* **4**: 239–275.

Easterly W, Levine R. 1997. Africa's growth tragedy: policies and ethnic divisions. *Quarterly Journal of Economics* **112**(4): 1203–1250.

Engerman S, Sokoloff K. 2005. Colonialism, inequality and long-run paths of development. NBER Working Paper 11057.

Ersado L. 2005. Small-scale irrigation dams, agricultural production, and health: theory and evidence from Ethiopia. World Bank Policy Research Paper 3494.

Filmer D, Pritchett L. 1999. Child mortality and public spending on health: how much does money matter? Mimeo, World Bank.

Fogel R. 2004. *The Escape from Hunger and Premature Death 1700–2100*. Cambridge University Press: Cambridge.

Frech H, Miller R. 1996. The productivity of health care and pharmaceuticals: an international comparison. UCLA Research Program in Pharmaceutical Economics and Policy research paper 97, 1.

Gomanee K, Morrissey O, Mosley P, Verschoor A. 2005. Aid, government expenditure and aggregate welfare. *World Development* **33**(3). 355–370.

Hanmer L, Lensink R, White H. 2003. Infant and child mortality in developing countries: analysing the data for robust determinants. *Journal of Development Studies* **40**(1). 101–118.

Hertz E, Hebert J, Landon J. 1994. Social and environmental factors and life expectancy, infant mortality and maternal mortality rates: results of a cross-national comparison. *Social Science and Medicine* **39**(1): 105–114.

DOI: 10.1002/jid

Hill K, Choi Y. 2004. The adult mortality in developing countries project: substantive findings. Paper Prepared for Adult Mortality in Developing Countries Workshop, Marconi Center, Marin County, California, 8–11 July 2004.

Hill K, Pande R, Mahy M, Jones G. 1998. *Trends in Child Mortality in the Developing World 1960–1996*. Johns Hopkins University: Baltimore, MD.

Ingram G. 1994. Social indicators and productivity convergence in developing countries. In *Convergence of Productivity: Cross-National Studies and Historical Evidence*, Baumol WJ, Nelson RR, Wolff EN (eds). Oxford University Press: Oxford; 316–333.

Jamison D. 2006. Investing in health. In *Disease Control Priorities in Developing Countries*, Jamison D, Breman J, Measham A, Alleyne G, Claeson M, Evans D, Jha P, Mills A, Musgrove P. (eds). Oxford University Press: New York; 316–334.

Kenny C. 2005. Why are we so worried about income? Everything else that matters is converging. *World Development* **31**: (1). 1–19.

Korenromp E, Arnold F, Williams B, Nahlen B, Snow R. 2004. Monitoring trends in under-5 mortality rates through national birth history surveys. *International Journal of Epidemiology* **33**: 1293–1301.

Laxminarayan R, Chow J, Shahid-Salles S. 2006. Intervention cost-effectiveness: overview of main messages in health. In Jamison D, Breman J, Measham A, Alleyne G, Claeson M, Evans D, Jha P, Mills A, Musgrove P. (eds). *Disease Control Priorities in Developing Countries*. Oxford University Press: New York. 35–86.

Leipziger D, Fay M, Wodon Q, Yepes T. 2003. Achieving the Millennium Development Goals: The Role of Infrastructure. World Bank Policy Research Working Paper 3163.

Lena H, London B. 1993. The political and economic determinants of health outcomes: a cross-national analysis. *International Journal of Health Services* **23**(3): 585–602.

Lindeboom M, Portrait F, van den Berg G. 2003. Individual Mortality and Macro Economic Conditions from Birth to Death. Tinbergen Institute Discussion Paper TI 2003-072/3.

Lindert P. 1986. Unequal English wealth since 1670. *The Journal of Political Economy* **94**(6): 1127–1162.

Loevinsohn B, Harding A. 2005. Buying results? Contracting for health service delivery in developing countries. *Lancet* **366**: 676–681.

McGuire J. 2005. Basic health provision and under-5 mortality: a cross-national study of developing countries. *World Development* **34**(3): 405–425.

McGuire J. 2001. Social policy and mortality decline in East Asia and Latin America. *World Development* **29**(10): 1673–1697.

Moore M, Leavy J, Houtzager P, White H. 1999. Polity Qualities: How Governance Affects Poverty. IDS Working Paper 99.

Neary J. 2004. Rationalizing the penn world table: true multilateral indices for international comparisons of real income. *The American Economic Review* **94**(5): 1411–1428.

Preston S. 1975. The changing relation between mortality and level of economic development. *Population Studies* **29**(2): 231–248.

Pritchett L, Summers L. 1996. Wealthier is healthier. *Journal of Human Resources* **31**(4): 842–868.

Ranis G, Stewart F. 2001. Growth and human development: comparative Latin American experience. *The Developing Economies* XXXiX-4: 333–365.

Ravallion M. 1997. Good and bad growth: the human development reports. *World Development* **25**(5): 631–638.

Sab R, Smith S. 2001. Human Capital Convergence: International Evidence. IMF Working Paper 01/32.

DOI: 10.1002/jid

Steckel R. 2001. Health and Nutrition in the Preindustrial Era: Insights from a Millennium of Average Heights in Northern Europe. NBER Working Paper 8542.

Strauss J, Thomas D. 1998. Health, nutrition and economic development. *Journal of Economic Literature* **36**(2): 766–817.

Summers R, Heston A, Aten B. 2002. Penn World Table Version 6.1. Center for International Comparisons at the University of Pennsylvania (CICUP).

Szretzer S. 1997. Economic growth, disruption, deprivation, disease and death: on the importance of the politics of public health for development. *Population and Development Review* **23**(4): 693–728.

Taylor A. 2002. Globalization, Trade and Development: Some Lessons from History. NBER Working Paper 9326.

Thorbecke E, Charumilind C. 2002. Economic inequality and its socioeconomic impact. *World Development* **30**(9): 1477–1495.

Toyama H. 2004. *Armament Situations in Southeast Asian Nations*. Japan Defence Research Center: Tokyo.

Wagstaff A. 2001. Child Health on a Dollar a Day: Some Tentative Cross-Country Comparisons, Mimeo, World Bank.

Wagstaff A. 2005. The Economic Consequences of Health Shocks. World Bank Policy Research Working Paper 3644.

Wang L. 2002. Health Outcomes in Low Income Countries and Policy Implications: Empirical Findings from Demographic and Health Surveys. World Bank Policy Research Working Paper 2831.

Weil D. 2005. Accounting for the Effect of Health on Economic Growth. NBER Working Paper 11455.

World Bank. 2003. *The Millennium Development Goals in Health: Rising to the Challenge*. World Bank: Washington DC.

World Bank. 2005. *World Development Indicators*. World Bank: Washington DC.

World Bank. 2006. *World Development Report: Equity and Development*. Oxford: New York.

Younger S. 2001. Cross-Country Determinants of Declines in Infant Mortality: A Growth Regression Approach, Mimeo, Cornell University Food and Nutrition Program.

DOI: 10.1002/jid