UNITED NATIONS DEVELOPMENT PROGRAMME

The Asymmetric Impact of Growth Fluctuation on Human Development:

Evidence from Correlates of Growth Decelerations and Accelerations

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A UNDP/ODS Working Paper

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United Nations Development Programme, New York
—May 2009—

Note: The views expressed in this paper are those of the authors and do not necessarily reflect those of UNDP. The authors thank Jorge Arbache, Nora Lustig, and colleagues at the Office of Development Studies, the Human Development Report Office, the Bureau for Development Policy, the Regional Bureau of Latin America and the Caribbean, and the Regional Bureau of Africa at UNDP for helpful comments. Nina Thelen provided excellent research assistance. Please send comments and suggestions to the following e-mail addresses: Pedro.Conceicao@undp.org, Namsuk.Kim@undp.org.

The Asymmetric Impact of Growth Fluctuation on Human Development: Evidence from Correlates of Growth Decelerations and Accelerations

Abstract

This paper studies the impact of growth fluctuation on human development indicators using country level panel data between 1980 and 2006. The evidence from mean comparison and regression analysis suggests that, globally and on average, periods of decelerating economic growth are correlated with worse indicators of health and education outcomes and that the reverse happens for periods of growth accelerations. However, in line with the findings from the literature, these effects are asymmetric: things do not improve as much during good times as they worsen during bad times. And the negative effects of growth collapses are severe for developing countries, especially for LDCs, along with little or no improvement during good times.

Keyword: Human development, Growth acceleration and deceleration, Developing countries

JEL classification: O11, O15, O47

1. Introduction

The relationship between economic growth and human development indicators (such as poverty rates, health and education outcomes) can be analyzed both in terms of longer-term trends and shorter-term fluctuations. At the aggregate level and over the long-run, there is a strong positive (though not linear) correlation between gross domestic product (GDP) per capita and human development indicators. But the direction of causality may run both ways: economic growth helps to generate the resources needed for improved human development, and improved human development enables higher potential growth.[1]

Shorter term fluctuation of growth can also affect the human development. Based on the literature that identifies episodes of growth accelerations and growth decelerations (see Hausmann, Pritchett, and Rodrik 2005; Hausmann, Rodriguez, and Wagner 2006; Imam and Salinas 2008), a study identify those episodes for African economies and find that episodes of growth decelerations are correlated with the worsening of human development indicators and that episodes of growth accelerations are correlated with small improvements in human development indicators (Arbache and Page 2007). Thus, the effects are asymmetric in African countries: the negative impact of economic decelerations on human development outcomes is greater than the positive impact of economic accelerations.

To explore the impact of growth fluctuations on human development indicators more precisely, a replication and expansion of Arbache and Page (2007) is undertaken. Using the growth rate and human development indicators for nearly 200 countries between 1980 and 2006, we find that growth acceleration and deceleration have significant impact on the human development indicators that are related to health and education. The result is verified by panel regressions with country specific time trend, because simple correlates may not be effective to capture the impact. The asymmetry between the negative impact of deceleration and the positive impact of acceleration is observed especially for the Least Developed Countries.

2. Data and Descriptive Statistics

Growth refers to annual changes in real GDP per capita in 2005 PPP from 1980 to 2009. Data on annual growth rates from 1980 to 2006 are obtained from World Bank (2008) and we use IMF's growth projection for 2007-2009 (IMF 2009). Since we use four year moving averages to identify growth acceleration and deceleration episodes, the sample time period is from 1983 to

[1] There is a vast literature on this issue. For example, Lustig, Arias and Rigolini (2002) review the theoretical and empirical evidence on economic growth and poverty reduction and suggest the possibility of a dual causality: economic growth may help reduce poverty, and reducing poverty can also help boost economic growth. Pritchett and Summers (1996) suggest that higher income is an important determinant of improved health outcomes. Commission on Macroeconomics and Health (2001), Bloom and Canning (2005), and Weil (2007) show that improved health promotes economic growth. Krueger and Lindahl (2001), and Wasmer and others (2007) survey the literature and suggest the positive contribution of education to economic growth. Foster and Rosenzweig (1996) examine the Green Revolution period in India and observe a reverse causal relationship between education and growth (more-educated households are more willing to adopt high-yielding crop varieties and thus earn higher income).

2006. Thus we have a panel data for 200 countries for 24 years, which is unbalanced due to unavailability of human development indicators for a few years. Data on human development indicators are taken from World Bank (2008), unless noted otherwise.

The definition of growth acceleration and deceleration follows Arbache and Page (2007). In particular,

- A growth acceleration is a period that satisfies the following four conditions:
    - Condition 1 – The forward four-year moving average growth minus the backward four-year moving average growth > 0 for a given year; i.e., the forward moving average window (t, t+1, t+2, t+3) must be higher than the backward window (t, t-1, t-2, t-3) and above 0;
    - Condition 2 – The forward four-year moving average growth exceeds the country's average growth, meaning that the pace of growth during acceleration is higher than the country's trend;
    - Condition 3 – The forward four-year moving average GDP per capita exceeds the backward four-year moving average;
    - Condition 4 – A growth acceleration episode requires at least three years in a row satisfying conditions 1-3. An episode includes the three subsequent years after the last year that satisfies conditions 1-3.

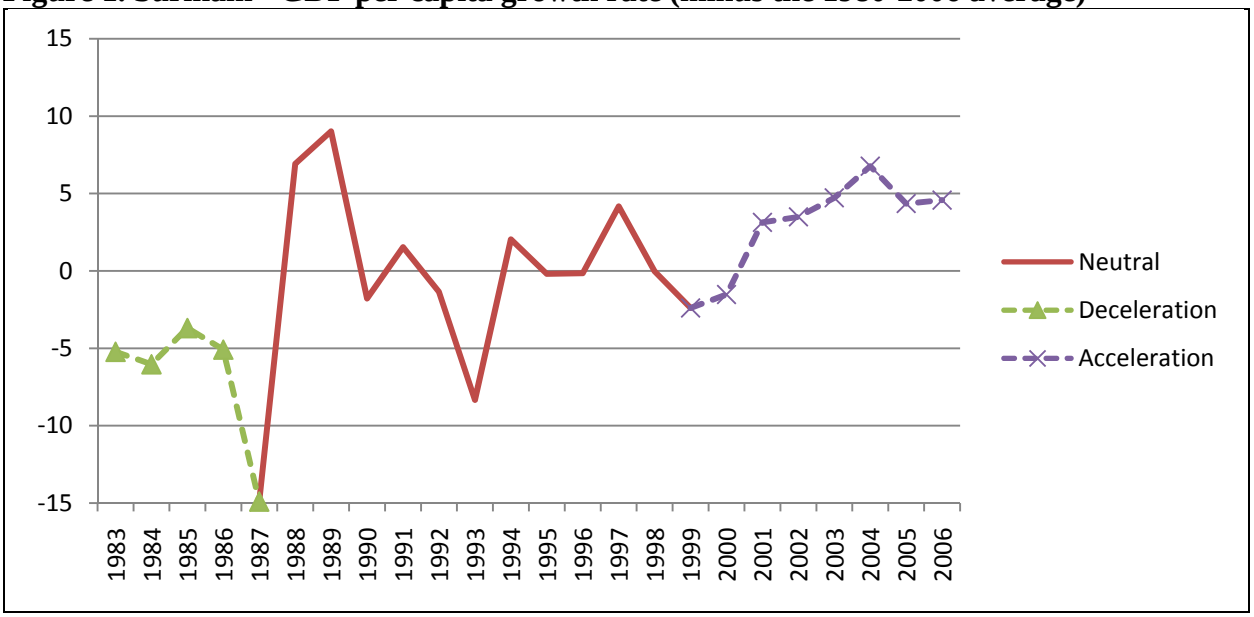
- A growth deceleration is a period that satisfies the following four conditions:
    - Condition 1 – The forward four-year moving average growth minus the backward four-year moving average growth < 0 for a given year;
    - Condition 2 – The forward four-year moving average growth is below the country's average growth;
    - Condition 3 – The forward four-year moving average GDP per capita is below the backward four-year moving average;
    - Condition 4 – A growth deceleration episode requires at least three years in a row satisfying conditions 1-3. An episode includes the three subsequent years after the last year that satisfies conditions 1-3.

- If neither of two sets of conditions applies, a period is considered as a "neutral" period.

Condition 1 identifies a kink in growth trend. If the forward average growth is higher than the backward average growth, the year is considered to be in an acceleration phase. If the sign of the difference in averages changes from positive to negative, or vice versa, it suggests a shift in growth trend. Condition 2 eliminates the long term growth trend component, especially in countries with very low or very high growth rates for a number of years. Condition 3 considers the level of GDP, not the annual growth rates, to separate the growth acceleration episode from a part of recovery from a recession. Condition 4 ensures the episode is not a temporary phenomenon for a couple years, but a significant deviation from the underlying trend.

Figure 1 illustrates the methodology to identify growth acceleration and deceleration episode. Surinam experienced growth deceleration between 1983 and 1987, with growth rates significantly lower than the long term average growth rates (.5% for the sample period). In 1988 and 1989, there was a higher growth, but it is a recovery from a recession, not a sustained acceleration (Condition 3 not satisfied). All the years from 1988 to 1998 failed to satisfy Condition 1, 2 or 4, charactering the period as a neutral episode with high volatility. Since 1999, the country experienced a growth acceleration episode.

Figure 1. Surinam - GDP per capita growth rate (minus the 1980-2006 average)



Using the identification of growth acceleration and deceleration, Table 1 provides information that allows for the comparison of the average levels of several human development indicators during economically good times and bad times. We look at six human development indicators, three on health and three on education: life expectancy, infant mortality rate, under 5 mortality rate, literacy rate, primary school enrollment rate, and secondary school enrollment rate. Columns 2 and 3 show the sample means of these six human development indicators during episodes of growth accelerations (During A) and episodes classified "otherwise" including both deceleration and neutral (Otherwise A). To compare whether the improvements in human development indicators during economic good times compared to other episodes are statistically significant, we also conduct a t-test on the difference between the mean of each human development indicator during episodes of growth accelerations and the mean during episodes "otherwise".

Table 1. Difference between Sample Means, Global Average, 1983-2006

	Growth Acceleration		*Growth Deceleration*	
	During A	Otherwise A	During D	Otherwise D
All countries				
Life expectancy (years)	69.4**	63.5	62.3**	65.3
	(0.26)	(0.2)	(.54)	(.17)
Infant mortality (per 1,000	27.5**	51.9	55.6**	43.9
live birth)	(1.12)	(1.12)	(3.1)	(.92)
Under 5 mortality (per 1,000)	43.6**	83.9	94.6**	70.8
	(2.13)	(2.05)	(5.84)	(1.7)
Literacy (% of adult)	78.4	74.6	66.7**	77.9
	(1.81)	(2.12)	(4.6)	(1.4)
Primary school enrollment	100**	98.2	96.3*	99.9
(net, %)	(0.57)	(.79)	(2.3)	(.48)
Secondary school enrollment	71.8	69.6	52.4**	72.2
(net, %)	(1.08)	(1.3)	(3.04)	(.86)
Developing countries				
Life expectancy	65.0**	58.4	59.9	60.1
	(.35)	(.24)	(.58)	(.22)
Infant mortality	45.1**	80.5	71.6	70.2
	(1.7)	(1.5)	(3.5)	(1.4)
Under 5 mortality	69.5**	127.9	113.3	111.9
	(3.1)	(2.7)	(6.3)	(2.4)
Literacy	76.5	70.9	65.6*	75.2
	(2.01)	(2.5)	(4.7)	(1.67)
Primary school enrollment	100**	96.1	96.1	98.9
	(.7)	(1.1)	(2.4)	(.65)
Secondary school enrollment	63.6**	54.9	50.7**	60.8
	(1.2)	(1.4)	(3.1)	(.94)
Developed countries				
Life expectancy	76.1**	72.2	72.2	73.3
	(.16)	(.16)	(.41)	(.14)
Infant mortality	7.6**	17.7	14.2	14.9
	(.45)	(.58)	(1.2)	(.47)
Under 5 mortality	9.8**	23.2	19.3	19.6
	(.96)	(1.07)	(2.6)	(.87)
Literacy	92.5	88.9	99.7	89.8
	(1.6)	(1.5)	(N.A.)[a]	(1.2)
Primary school enrollment	102.7	102.2	102.1	102.4
	(.65)	(.63)	(2.8)	(.46)
Secondary school enrollment	99.3	97.2	84.8	98.3
	(1.6)	(1.1)	(4.6)	(.92)

Note: Data are obtained from World Bank (2008b); Standard error in parentheses; each indicator is a population weighted sample mean; [a] not available because there is only one observation; * denotes the difference between the sample mean of "during" and "otherwise" is significantly different from zero at 5 percent; ** significant at 1 percent; Number of countries varies across indicators: 200 for life expectancy, 191 for mortality rates, 138 for literacy, and 188 for school enrollment rates.

From Table 1, we see that the average levels of all six human development indicators are better during episodes of growth accelerations (During A) than those during episodes otherwise (Otherwise A) but are worse during episodes of growth decelerations (During D) than those during episodes otherwise (Otherwise D). It suggests that not only the long term growth, but also the shorter term deviations, growth acceleration and deceleration, is associated with changes in human development outcomes.

The t-test results (reported as * and **) in column 2 (During A) conclude that the differences between the average levels of human development indicators during economic good times and the average levels of human development indicators during episodes "otherwise" are positive and statistically significant for all human development indicators except for literacy rate and secondary school enrollment rate. The t-test results in column 4 (During D), on the contrary, show that the average levels of all human development indicators are statistically significantly worse during episodes of growth decelerations than during episodes "otherwise".

The relationship between growth episodes and human development outcomes is not the same for all countries. In developing countries, the results show that five out of six human development indicators in developing countries are statistically better during growth accelerations, but only two of them are statistically worse during decelerations. For developed countries, three health related indicators improve (statistically significant) during growth accelerations, but deteriorate little (statistically insignificant) during growth decelerations. The three education indicators do not show any statistically significant difference during episodes of growth accelerations or decelerations.

The result of the simple mean comparison is consistent with findings in the existing literature.[2] In a review of studies related to the effects of economic shocks on health, Ferreira and Schady (2008) conclude that economic crises tend to have negative effects on health and nutrition outcomes for children in poor countries but typically have positive effects for children in rich countries. The evidence for middle income countries is mixed. For some middle-income countries like Mexico, Peru and Russia, negative economic shocks affected child health and nutrition negatively. But for others such as Colombia, the impact was positive.

These results have to be interpreted carefully, because simple correlates may not reflect the true relationship. In Table 2, the evolution of the frequency of episodes of both growth accelerations

[2] Many other studies find a strong correlation among economic shocks, poverty, health and education indictors for developing countries, but the evidence is mixed for developed countries. To name a few, Banerjee and Duflo (2007) find a strong positive association between poverty and mortality rates in Vietnam and Indonesia. Cutler and others (2002) study the Mexican 1995-1996 economic crisis, and Paxson and Schady (2005) examine the Peruvian 1988-1990 economic crisis to find that there was a sharp increase in the infant mortality rate during the crises. Sachs (1996) showed that the transition process undertaken by many countries in Eastern Europe and Central Asia often go along with a deterioration of living standards, increased mortality rates, and the consequent reduction in life expectancy. For rich countries, Dehejia and Lleras-Muney (2004) find that infant mortality improves in the U.S. during recessions. Ferreira and Schady (2008) show that school enrollment rates tends to decline in low-income countries but increase in high-income countries, while the impact of economic crisis on school enrollment or attainment rates in middle-income countries is ambiguous.

and decelerations in the period under analysis is such that accelerations have become more frequent (from .22 in 1980s to .49 in the 2000s), while decelerations are less frequent (from .19 in the 1980s to .04 in the 2000s). And the human development indicators improved worldwide in the long run. As a result, it is possible that larger number of acceleration episodes could coincide with improved human development, even though there might be no relationship between them. Thus, the comparison of means might just be capturing this effect, rather than a distinct difference across accelerations and decelerations in terms of average levels of human development indicators.

Table 2. Frequency of Growth Acceleration and Deceleration Episodes and Average Growth Rates by Decade

	Overall period	**Growth acceleration**		**Growth deceleration**	
	Annual Average GDP growth rate	Frequency (country-years)	Annual Average Growth rate	Frequency (country-years)	Annual Average Growth rate
1983-1989	1.30	0.22	3.87	0.19	-2.42
1990-1999	1.07	0.36	3.70	0.13	-4.96
2000-2006	3.00	0.49	4.44	0.04	-2.76
1983-2006	1.72	0.36	4.03	0.12	-3.58

Note: Annual average GDP growth rate is unweighted average of GDP per capita growth in 2005 PPP.

Therefore, the analysis is complemented with a panel regression that simultaneously controls for both country-specific effects (the country-specific evolution of health and education indicators) and the time-trend effect (the long-term trend that underlies the evolution of each of these indicators). The coefficient estimates captures the "correlation" of the human development indicators level that are not specific to the time trend or each country's characteristics. Obviously, these results do not allow for drawing any causal inferences, but the coefficient estimates shed light on how much on average past episodes of good and bad times correlated with differences in the levels of human development indicators relative to the trend, that is, accounting for (unspecified) time-specific effects.

3. Regression Analysis of Human Development Indicators and episodes of Growth Accelerations and Decelerations

To find the historical relationship between human development indicators and growth fluctuations, we run the following regression using the panel data from 1983 to 2006:

(1) $$HD_{i,t} = \beta_0 + \beta_1 ACC_{i,t} + \beta_2 DEC_{i,t} + \beta_3 TIME_t + \varepsilon_{i,t}$$

$$for \quad i = 1, \cdots, N; \quad t = 1, \cdots, T$$

HDi,t is the level of a human development indicator for country i at time t; $ACC_{i,t}$ is a dummy variable for episodes of growth accelerations; $DEC_{i,t}$ is a dummy variable for episodes of growth decelerations; $TIME_t$ is a cubic time trend (β_3 is a vector of coefficients and $TIME_t$ is a vector with a linear, quadratic and cubic time variable; the product of the two vectors refers to the

internal product).[3] For the year of acceleration (ACC=1), the fitted value of HD has two constants ($\beta_0 + \beta_1$) and the time trend. For the year of deceleration (DEC=1), the fitted value has two constants ($\beta_0 + \beta_2$) and the time trend. For the neutral year, the fitted value has a constant (β_0) and time trend. Therefore, the coefficient estimates from ACC and DEC can be interpreted as the average difference of human development indicators from the underlying trend in the neutral period.

The OLS estimates of the coefficients are presented in Table 3. As would be expected, the use of a pooled panel estimator leaves much variation unexplained, but the coefficients on accelerations and decelerations do capture the mean relationship between good and bad times and human development indicators.

[3] Since many of the human development indicators are serially correlated, the best possible specification would be to take the first or second difference of the dependent variable. But this method is not feasible because the data is sporadic - human development indicators are not available for every year even for high income countries. As an alternative, we use a time trend as a regressor. Since a time trend would not necessarily make the dependent variable stationary in our specification, the error term might be serially correlated within group. We tested the existence of correlation with the robust covariation matrix estimation, and found little changes in our estimates.

Table 3. Pooled OLS Regression of Human Development Indicators, 1983-2006

	Life expectancy	Infant mortality	Under-5-mortality	Primary school enrollment	Secondary school enrollment	Literacy
All countries						
ACC	1.653	-8.193	-12.077	1.984	-1.680	1.133
	(3.88)**	(3.74)**	(2.94)**	(2.01)*	(0.99)	(0.38)
DEC	-4.679	19.239	36.916	-0.450	-16.549	-10.529
	(7.73)**	(5.84)**	(5.99)**	(0.23)	(4.90)**	(2.29)*
Constant	65.538	41.438	65.901	102.689	156.399	84.646
	(248.16)**	(29.00)**	(25.00)**	(2.61)**	(2.52)*	(4.65)**
Observations	4394	2870	2466	1465	1418	250
R-squared	0.14	0.13	0.13	0.02	0.04	0.03
Number of country	200	199	199	188	188	138
Developing countries						
ACC	2.033	-9.174	-14.402	3.565	4.782	
	(3.82)**	(3.28)**	(2.84)**	(2.58)**	(2.40)*	
DEC	-3.090	11.668	21.631	4.038	-0.807	
	(4.33)**	(2.95)**	(3.03)**	(1.71)	(0.22)	
Constant	61.834	66.300	107.703	110.060	92.269	
	(36.92)**	(8.54)**	(7.17)**	(2.02)*	(1.31)	
Observations	1581	925	817	1021	899	
R-squared	0.04	0.06	0.06	0.03	0.04	
Number of country	138	131	131	125	108	
Least Developed Countries (LDCs)						
ACC	-0.295	3.930	7.630	2.287	-1.204	
	(0.37)	(0.92)	(0.96)	(0.72)	(0.51)	
DEC	-3.277	16.003	33.542	9.683	0.049	
	(3.39)**	(2.86)**	(3.24)**	(1.91)	(0.01)	
Constant	49.528	115.894	186.028	68.237	5.163	
	(19.46)**	(9.40)**	(8.18)**	(0.54)	(0.06)	
Observations	479	276	276	341	277	
R-squared	0.07	0.14	0.13	0.08	0.08	
Number of country	48	46	46	41	34	

Note: Absolute value of t statistics in parentheses; * significant at 5 percent; ** significant at 1 percent; Literacy is not analyzed for developing countries and LDCs because the number of observations is small; Coefficients estimates for cubic time trend are available from the authors.

Overall, health related indicators show a statistically significant relationship with episodes of growth accelerations and decelerations. Compared to its underlying time trend, life expectancy is about 1.7 years higher during episodes of growth accelerations and 4.7 years lower during episodes of growth decelerations; infant mortality is reduced by 8.2 per 1000 births during episodes of growth accelerations and increases by 19.2 per 1000 births during episodes of growth decelerations; under-5 mortality is 12 per 1000 births lower during economic good times but 36 per 1000 births higher during economic bad times. These coefficients estimates are all statistically significant.

On the other hand, the relationship between education outcomes and episodes of growth accelerations or decelerations is not clear. During episodes of growth accelerations, only the primary school enrollment is found to be statistically improved, that is, 1.9 percentage point higher than the underlying time trend. In case of the secondary school enrollment and literacy, the coefficient estimates for ACC are not statistically significant. During episodes of growth decelerations, the literacy rate and the second school enrollment rate are statistically worsened by -10.5 and -16.5 percentage points, respectively. But there is no statistically significant deterioration in the primary school enrollment rate when economic growth decelerates.

Table 3 also presents the pooled regression results for subgroups of developing countries and LDCs.[4] For developing countries, all three health indicators improve during acceleration. Life expectancy is higher by 2.0, infant mortality rate is lower by 9.2, and under-5 mortality rate is lower by 14.4 percentage point during acceleration compared to the underlying time trend. During growth deceleration episodes, the indicators are worse by -3.1, 11.7, and 21.6 percentage points, respectively. These estimates are all statistically significant. For education indicators, the coefficient estimates are significant for ACC: 3.6 for primary school and 4.8 for secondary school. The estimates are not statistically significant for DEC.

LDCs are heavily penalized in health related indicators when they fall into growth decelerations. Infant mortality is 16 percentage point higher during deceleration, and under-5 mortality is 33.5 percentage point higher compared to the underlying time trend. Life expectancy is also lower by 3.3 percentage point during deceleration. While these estimates for DEC are statistically significant, the coefficient estimates for ACC (-.3 for life expectancy, 3.9 for infant mortality, and 7.6 for under-5 mortality) are statistically equal to zero, implying that infant and under-5 mortality rates do not improve statistically during episodes of growth accelerations. The result suggests that economic fluctuations could have asymmetric impacts on human development outcomes. For LDCs, statistically, some human development indicators deteriorate during economic bad times while they do not improve during economic good times.

The asymmetric and heterogeneous impacts in the regression analysis are consistent with findings in other studies.[5] For example, Baird, Friedman and Schady (2007) investigate the

[4] Developed countries do not show a statistically significant relationship between human development indicators and episodes of growth accelerations or decelerations.

[5] The asymmetry may exist in many dimensions, for example, gender. Schultz (1997) points out that an increase in child mortality will probably place additional burdens on women because of their roles as child bearers and care givers.

relationship between short-term fluctuations in aggregate income and infant mortality using a large dataset of 59 developing countries. The authors find that there is a large negative relationship between per capita GDP and infant mortality and the impact of economic fluctuations on infant mortality is highly asymmetric depending on whether the economic fluctuation is a contraction or an expansion. The negative impact of contractions on infant mortality rates tends to be bigger than the positive impact of expansions.

To check the robustness of our panel regression results, we run fixed effect regressions with country-specific time trends. The fixed effect regressions yield results in Table 4, similar to the result from our pooled regressions. Compared to the pooled regressions with a common time trend, fixed effects regressions with a country-specific time trend will control for the cross-country variation in economic fluctuations and human development outcomes. The increased R-squared suggests that the within-group variation is well explained with country-specific time trend. Health related indicators (life expectancy, infant mortality rate, and under-5 mortality rate) are significantly related with episodes of growth accelerations and decelerations, while education related indicators (literacy, enrollment rates) are not. The results are consistent with what we find in the pooled panel regressions.

Table 4. Fixed Effect Regression of Human Development Indicators, 1983-2006

	Life expectancy	Infant mortality	Under-5-mortality	Primary school enrollment	Secondary school enrollment	Literacy
ACC	2.84	-14.72	-25.26	-.15	-.55	1.36
	7.77)**	(-7.62)**	(-6.67)**	(-.38)	(-4.56)	(.78)
DEC	-1.86	11.88	24.01	2.93	2.36	-17.37
	(-4.07)**	(4.75)**	(5.06)**	(2.31)*	(1.77)	(-5.91)*
Constant	64.37	45.62	72.45	111.83	60.52	79.71
	(348.69)**	(43.3)**	(36.58)**	(22.77)**	(14.24)**	(24.77)
Observations	4394	2870	2466	1465	1418	250
R-squared	0.67	0.68	0.68	0.98	0.99	0.86
Number of countries	200	199	199	188	188	138

Note: Absolute value of t statistics in parentheses; * significant at 5 percent; ** significant at 1 percent.

4. Conclusion

The main finding on the impact of economic fluctuations is that the growth acceleration episodes are associated with improvement in human development, and the growth deceleration episodes are associated with deterioration in human development. But there is heterogeneity across the income level of countries, and asymmetry between the acceleration and deceleration. The result is consistent in the simple mean comparison, the pooled OLS panel regression and the fixed effect panel regression with country specific time trend using data on 200 countries between 1980 and 2009.

Human development indicators either deteriorate or improve at a slower pace during an economic crisis in poor developing countries, especially for the poorest populations. The regression analysis suggests that the positive impact of growth acceleration is smaller than the negative impact of growth deceleration on health related human development indicators. This asymmetry implies that low income countries do not benefit much from the boom, but do pay highest price for the recession in terms of human development.

If the pattern found in our empirical analysis persists, given that all countries are likely to face recessions at the same time during this global economic downturn, not only will developing countries face setbacks in human development outcomes, but the long-running trend of convergence in many human development indicators across countries may slow down or even reverse. To avoid that a global economic crisis turns to be a global human crisis, policy response is needed to mitigate the adverse income shocks and promote social protection in developing countries.

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