St Comp Int Dev (2007) 42:1–35
DOI 10.1007/s12116-007-9003-7

Reassessing the Effect of Economic Growth on Well-being in Less-developed Countries, 1980–2003

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Published online: 22 September 2007

Abstract Development debates have been greatly influenced by the growth consensus: the conventional wisdom that economic growth should be the primary priority for less-developed countries (LDCs) because it most effectively improves the well-being of the world's poor. We compare the impact of growth to other independent variables in an unbalanced panel analysis of up to 109 LDCs and 580 observations across six time points (1980, 1985, 1990, 1995, 2000, and 2003). Our dependent variables include caloric consumption, infant survival probability, one-to-five year survival probability, female life expectancy, and male life expectancy. First, we find that gross domestic product (GDP) has significant positive effects on caloric consumption, female life expectancy, and male life expectancy. Second, GDP does not have robust effects on infant and one-to-five survival probabilities. Third, fertility, urbanization, and secondary school enrollment have larger effects than GDP in the majority of models. The more powerful effects of fertility, urbanization, and secondary schooling cannot simply be attributed to an indirect effect of GDP. Fourth, we find that dependency variables do not have robust significant effects. Fifth, over time, GDP has become much less effective at improving caloric consumption and infant and one-to-five survival. We infer that there are serious limitations to concentrating exclusively on economic growth to improve well-being in LDCs.

Keywords Economic growth · Well-being · Health · Development

An earlier version of this paper was presented at the Southern Sociological Society meetings in New Orleans, LA, the Program for Advanced Research in the Social Sciences of Duke University, and the Department of Sociology of the University of North Carolina at Charlotte.

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Introduction

Development debates have been greatly influenced by the growth consensus: the conventional wisdom that economic growth should be the primary priority for less-developed countries (LDCs) because it most effectively improves the well-being of the world's poor. This view is widely held across the social sciences. This view is probably dominant within economics (Bhagwati 2004) and was even expressed by classical economists (Mill 1963: 216; Hayek 1994: 20). Over the past 10–15 years, development economics has enjoyed resurgence and, as a result, development policy debates remain deeply shaped by the growth consensus (Dollar and Kraay 2000). Glenn Firebaugh and Frank Beck (1994: 648) state, "The belief that economic growth benefits most people is the bedrock assumption of much development policy." Jeffrey Sachs (2005) recently wrote: "Market economics and globalization are lifting the bulk of humanity out of extreme poverty.... Economic growth has shown a remarkable capacity to lift vast numbers of people out of extreme poverty." While often recognizing the value of other influences on well-being (e.g., education or health services), growth tends to be prioritized.

Certainly, there are critics of what Martha Nussbaum (2004: 329) refers to as this "still-dominant economic growth paradigm." Many problematize the "Washington Consensus" that is focused on growth, and the free markets and privatization that purportedly foster it (Stiglitz 2002). Recently, the World Bank and others have debated and reconsidered the relevance of institutions, politics, gender, and other concerns besides growth. Yet, across most of the social sciences, growth is still considered the central, primary concern for improving well-being in LDCs.

Our study aims to reassess the effect of growth on well-being in LDCs. We examine five dependent variables as measures of well-being. We scrutinize the effect of growth alongside a variety of other independent variables and compare the significance and relative size of coefficients. Most critically, we employ a far more comprehensive sample with more countries and years than is typical for this area. We also use more recent data on LDCs (1980–2003). While we acknowledge, replicate, and incorporate the methodological concerns of exemplary studies in this area, we employ a strategy that aims to improve upon the extant literature.

Exemplary Studies of the Benefits of Growth

One key starting point for our analysis is an influential article by Firebaugh and Beck (1994). The authors tested the effect of gross domestic product (GDP) on four measures of well-being in 62 LDCs from the 1960s to 1980s. We interchangeably refer to "growth" and "GDP," even though we follow Firebaugh and Beck and almost all studies and test the level of GDP.[1] Based on models with four controls, they concluded, "Economic growth has demonstrable benefits on national welfare in the Third World. Economic growth is the only variable ... that shows consistent, non-trivial effects on all four indicators of national welfare" (648). By contrast, trade and

[1] In sensitivity analyses in Appendix I, we test the rate of change in GDP (i.e., growth) and find identical results.

foreign direct investment (FDI), dependency variables common in sociology, did not have robust negative effects. Moreover, they wrote: “The effects of economic growth on national welfare are large and robust, whereas the effects of dependence are hard to find” (631, 647). Since Firebaugh (1992) had shown that trade and FDI did not harm the growth of LDCs, Firebaugh and Beck, and later Firebaugh and Brian Goesling (2004) contended that integration into the global economy benefited LDCs.[2]

Firebaugh and Beck explain that capitalists must invest their profits and, through the natural distribution of markets, this investment leads to greater economic resources for the broader population. Even if dependency leads to inequality and some *relative* deprivation, most of the population reaps *absolute* gains through rising standards of living, increased wages, and ultimately better well-being. In LDCs, where the median standard of living is still quite low, this *absolute* deprivation is paramount. The authors had a tremendous impact on development sociology and, one sign of this is that no study has ever really questioned or revisited their analyses.[3] If they are correct and growth is the most powerful means for lifting well-being in LDCs, then growth *should* be the first priority for LDCs.

The Firebaugh and Beck article is just one of many that conclude growth is central to well-being in LDCs. Lant Pritchett and Lawrence Summers’ (1996) similar analysis of GDP’s effect on infant mortality also serves as a recurring comparison. Demographers often orient their analyses of well-being in LDCs around the effect of growth (Hales et al. 1999; Hertzman and Siddiqi 2000; Preston 1975b). As Samuel Preston (1996: 531) remarked, “The major emphasis during the last half-century, however, has been on explaining movements in aggregate-level indices of mortality by reference to economic factors.” One sign of the conventional wisdom of growth’s benefits is that many include GDP as a control, and find significant effects for various measures of well-being in LDCs (Beckfield 2004; Bradshaw et al. 1993; Bradshaw and Huang 1991; Jenkins and Scanlan 2001; London and Williams 1990; Shen and Williamson 1997; Stokes and Anderson 1990; Wimberly 1990; Wimberly and Bello 1992).

Limitations of the Growth Consensus

Using the exemplary studies by Firebaugh and Beck, Pritchett and Summers, and others for comparison, we present four motivations for reconsidering the effect of growth on well-being in LDCs.

[2] Much of Firebaugh and Beck’s focus was on challenging dependency/world systems claims about the damaging influence of unequal trade and exploitive FDI. They criticized semi-difference analyses stressing the lower well-being caused by trade and FDI (London and Williams 1990; Stokes and Anderson 1990; Wimberly 1990; Wimberly and Bello 1992).

[3] Several have disputed Firebaugh (1992) and sought to show that FDI actually harms the growth of LDCs (Dixon and Boswell 1996), but, to our knowledge, no response to Firebaugh and Beck’s 1994 article has appeared.

Problems with the GDP to Well-being Link

Many growth proponents take for granted the link between gross domestic product per capita (GDP) and well-being. Growth proponents often assume GDP is equivalent to utility—based on the economic assumption that higher GDP means more choice and choice equals utility—and utility is equivalent to well-being.[4] Dale Wimberly and Rosario Bello (1992: 898) explain that many *defined* GDP as development and "assumed that economic growth would almost automatically meet basic needs such as nutrition by increasing the size of the consumable 'pie.'" Since the incomes of the poor correlate with the average income of the country, GDP is considered a good approximation of the incomes of the poor (Dollar and Kraay 2000; but see Ravallion 2001). In contrast, we suggest there are both theoretical and empirical reasons to scrutinize the link between GDP and well-being.[5]

Theoretically, the connected literatures on capability and gender provide persuasive criticisms of equating GDP and well-being (Nussbaum 2000). Amartya Sen (1999), Dreze and Sen (1995), and Nussbaum and Sen (1993) forcefully demonstrate that income is not well-being, but is a resource that provides the capability to purchase well-being (what he calls freedoms). Sen (1999: 109) writes, "The relationship between income (and other resources), on the one hand, and individual achievements and freedoms, on the other, is neither constant nor in any sense automatic and irresistible." Scholars should end the presumption that GDP is the goal, and focus on capabilities. Doing so will call attention to a wider variety of processes, beside growth, that can enhance well-being. Similar arguments have been made by gender and development scholars (Blumberg 1995; Bose and Acosta-Belen 1995; Parpart et al. 2000). We cannot assume that growth benefits both women and men equally, and the concentration on GDP results in a gender blindness. The sources of women's and men's well-being may differ and to understand well-being fully, we must evaluate GDP alongside a variety of other influences.

Much of Firebaugh's (2003) celebrated recent work builds from the assumption that GDP indexes well-being. Firebaugh has shown that global inequality in GDP has narrowed over the past 50 years. Firebaugh principally analyzes GDP, and this choice is justified if one is persuaded by Firebaugh and Beck's conclusion that GDP predicts well-being very well. However, Goesling and Firebaugh (2004) have shown that global health inequality has very different patterns compared to global income inequality. While global inequality in GDP has declined (Firebaugh and Goesling 2004), global inequality in life expectancy has increased. Goesling and Firebaugh (2004) attribute this increased global health inequality to the AIDS crisis. But this cannot explain why life expectancy increased 8.8% in Latin America and the Caribbean and 15.7% in the Middle East and North Africa during the 1980s and 1990s (Goesling and Firebaugh 2004: 134), even though Latin America only grew 0.35% and the Middle East only grew 1.2% (Firebaugh and Goesling 2004: 286). These facts suggest that global health inequality may have decoupled from global

[4] Throughout, we are referring to material well-being (i.e., health), not psychological/subjective well-being.

[5] We do not mean to imply that we are the first to problematize GDP as an unqualified predictor of well-being, as there is much literature in that vein (e.g., Morris 1979).

income inequality in the 1990s. In turn, equating GDP and well-being may be even less appropriate in recent years.

Upon closer examination, GDP might not have consistent effects across all measures of well-being. Some measures, like average caloric intake, might have a stronger socioeconomic gradient (Jenkins and Scanlan 2001). If the rich raise their caloric intake substantially, the country's average might increase even though the majority has not experienced any real gain (Ravallion 2001). Other measures, like infant mortality, might be a better measure of the well-being of the poor (Bradshaw et al. 1993). Since the poor are much more vulnerable to child mortality, improvements in this measure might actually track improved well-being for the broader population (Preston 1996). Firebaugh and Beck justified their measures based on the size of the gains between the 1960s and 1980s. Because life expectancy, for example, had risen so dramatically over previous decades, the rich could not have monopolized these improvements. Yet, since some well-being measures are more vulnerable to this criticism, it is necessary to examine GDP's effects across measures.

Small Samples and Two Time Points

The samples in this area are typically limited in one of two ways. Studies either analyze many countries with one time point, or fewer countries and many time points. Both conventional strategies have compromised generalizability.[6] For example, one of the limitations of Firebaugh and Beck's study is the small sample of 62 LDCs. On balance, their sample was only slightly smaller than many of the studies they were criticizing, and social scientists routinely use comparable sample sizes. Still, their insignificant findings could be due to insufficient degrees of freedom. Other findings could be due to the lack of enough information to sort out the unique effects of different variables. At the very least, their conclusions should be reexamined in a more comprehensive sample of LDCs-especially since data are now available for far more LDCs and years. Pritchett and Summers (1996) use a much larger sample, but do so by combining developed countries and LDCs in one sample. To provide a more representative sample, we combine the encompassing sample of countries of the one time point studies with the temporal variation of the multiple time point studies.[7]

Again, taking Firebaugh and Beck as an influential exemplar, they justifiably employ a two-time point difference model (see below). However, a limitation of the two-time

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[6] The most common strategy remains less than 75 countries with the dependent variable at one time point (e.g., 1995) as a function of the dependent variable and independent variables many years before (e.g., 1980). This is the semi-difference model criticized by Firebaugh and Beck, which suffers from both problems.

[7] Despite using a semi-difference cross section of 59 LDCs, Shandra et al. (2003) conclude, "We need more longitudinal data both for our dependent and independent variables to understand the effects of these determinants on infant mortality. This would make it possible to pool cross-sectional data so as to increase the number of degrees of freedom making it possible to include more control variables in one model. We need data for more countries and for more time points." The major reason that studies as encompassing as ours have not been done is that a sample this large has been almost impossible to assemble before recent improvements in international data reporting.

point approach is that nonlinear development patterns in LDCs can be obscured. For example, a two-time point analysis of Nigeria in 1980 and 2003 shows modest progress, with the infant mortality rate declining from 108 to 98. Yet this two-time point approach hides that the infant mortality rate in Nigeria increased to 115 in 1990 and 120 in 1995 before falling to 102 in 2000.[8] A larger, multiple time-point sample could incorporate the greater historical fluctuation that LDCs, like Nigeria, routinely experience. Indeed, LDCs often cycle between periods of failure and periods of success.

Alternative Causes and Causal Primacy

Within exemplary studies, it is commonplace to stress how powerful the effects of growth are relative to other causes of well-being in LDCs. What is striking is how often only a few controls are included. For instance, Firebaugh and Beck claim: "Economic growth is the only variable ... that shows consistent, nontrivial effects on all four indicators of national welfare" (p. 648). Although they were referring to their models, this is a bold interpretation given they only include four other controls. Pritchett and Summers (1996) report a significant effect of GDP for infant mortality, but only include one control (years of schooling) and year dummies. Many studies are vulnerable to omitted variable bias, so our point is not simply that some other variable could be added. Rather, the question is whether adding salient controls results in one of two conclusions: (a) the effect of growth is not robust to this alternative specification; and/or (b) the controls have larger, more substantively significant effects than growth. If either is the case, this would problematize claims that GDP has robust effects, and that GDP is the only significant or most important cause.

There are good reasons to suspect that growth is not the most important cause of well-being in LDCs. Samuel Preston (1996) concludes that only about 20% of the global decline in mortality can be explained by GDP, whereas factors exogenous to growth account for 75–90%. Demographers have identified other salient causes of population health, and never considered growth the only cause or even a correlate that could account for the majority of the variation (Preston 1975b). Firebaugh and Beck included some of these as controls, which we retain below, including the dependency measures and the other measures that they found insignificant.

They found education was insignificant in most models. This is surprising because education is routinely a key predictor of population health (Pritchett and Summer 1996), especially because of its indirect influence through women's status (Caldwell 1986; Frey and Field 2000; Nussbaum 2004). A substantial expansion in schooling normally goes hand in hand with an expansion in female education (Nussbaum 2004). Preston (1996: 534) identifies several mechanisms between female education and well-being: "Education of mothers was influential in breaking down traditional attitudes to and practices of medicine, both because it enhanced the status of women in the home, and because schools connected girls to a different type

[8] Nigeria's per capita GDP in purchasing power parity dollars steadily declined: 1,220.52 (1980), 925.68 (1990), 890.60 (1995), 785.30 (2000) and 746.21 (2003). A two-time point approach would probably show a *positive* relationship between GDP and infant mortality. From 1980 to 2003, both GDP and infant mortality declined. In actuality, as GDP declined, infant mortality worsened from 1980 to 1995, and multiple time points would illustrate this.

of society in which health centres played an integral part." In addition, education has a powerful effect on mortality in individual-level analyses in LDCs (Hobcraft et al. 1984; Pritchett and Summers 1996). The cross-national expansion in schooling has diffused healthier behavior and parenting practices, and facilitated a wide variety of economic and noneconomic mechanisms, which influence health and well-being (Buchmann and Hannum 2001; Hannum and Buchmann 2003). While education and GDP are associated (Buchmann and Hannum 2001; Schafer 1999)—though not necessarily causally (Hannum and Buchmann 2003)—education may independently affect well-being in LDCs. For instance, K.A.S. Wickrama and Frederick Lorenz (2002) conclude that women's improved status, partly manifested in education, has an effect on women's health that cannot be explained by growth (Dreze and Sen 1995). Nussbaum (2004: 328) argues, "All concerned should recognize that promoting economic growth is not a sufficient way to promote education for women. Development theorists who focus only on maximizing economic growth, assuming that growth alone will provide for other central human needs, are very likely to shortchange female education."

In our analyses below, we add several new controls.[9] First, we include the total fertility rate. While fertility and mortality are linked in the demographic transition, and the demographic transition is associated with development generally, the decline of fertility may affect well-being independent from growth (Heuveline 2001; Bongaarts and Watkins 1996). As fertility declines, infant mortality, maternal morbidity and mortality decline, and life expectancy rises. Directly and mechanically, less fertility means less chance of maternal morbidity and mortality. Declining fertility also allows a society to reallocate health resources from routine births to the more vulnerable populations. Indirectly, the decline of fertility results in greater autonomy, increased schooling, and greater employment opportunities for women (Nussbaum 2000; Parpart et al. 2000; Sen 1999). Overall, less fertility reflects cultural change and a variety of positive development outcomes (Shen and Williamson 1997; Wickrama and Lorenz 2002).

Second, we include urbanization. In LDCs, urbanization is associated with access to clean water, and educational and medical facilities (El-Ghannam 2002). For example, David Cutler and Grant Miller (2005) find that access to clean water in urban areas accounts for most of the child mortality decline in the early twentieth-century United States. One mechanism by which urbanization improves well-being is greater access to health care services (Fosu 1989). Also, urbanization improves well-being by feeding back into lessened fertility and increased education (Li and Ballweg 1992). Equally important, urbanization may improve well-being because it is negatively associated with agricultural employment and positively associated with manufacturing employment. As the agricultural sector declines and industrialization occurs, well-being improves greatly.[10] Including agriculture or manufacturing

[9] We referred to 5 additional controls above. We discuss three in this section, and the 2 others (time and an interaction of GDP and time) in the next section.

[10] Urbanization negatively correlates with agricultural employment as a percent of total employment (−0.8) and positively correlates with manufacturing employment (0.6). Agricultural employment negatively correlates with and manufacturing employment positively correlates with our well-being measures (calories −0.6 and 0.7, infant survival −0.8 and 0.7, one to five survival −0.8 and 0.7, female life expectancy −0.8 and 0.7, and male life expectancy −0.7 and 0.7) (World Bank 2005).

measures causes a loss of about one-third of our sample, while urbanization data are widely available and thus are a useful proxy. Again, although urbanization is linked to rising GDP, the movement of the population from outlying rural areas can be beneficial in itself.

Finally, we include debt service. The debt crisis has hampered the budgets of LDCs and may indirectly reduce population well-being by triggering a decline in publicly provided health services, education, and public goods (Bradshaw et al. 1993; Bradshaw and Wallace 1996; Przeworski and Vreeland 2000; Sachs 2005). Although Firebaugh and Beck appropriately tested dependency explanations with the traditional measures of trade and FDI, York Bradshaw and Jie Huang (1991) argue that the debt crisis should be the more pressing contemporary dependency concern.

Ultimately, we conceive of development as a multidimensional process (Sen 1999). Growth might be a surface-level manifestation of development, and development may benefit well-being. But, other dimensions, even net of growth, could be more important to improved well-being in LDCs. These other dimensions might be associated with growth, but have independent exogenous influence on well-being.[11] In particular, we suspect that the controls we have identified have a greater influence on well-being, and a better specification of the model (by including these controls) could change our interpretation of the effects of growth. Rather than simply modeling the surface-level manifestation of development with growth, we seek a more precise understanding of the influence of specific, multiple dimensions of development. Ultimately, we seek to contribute to building a comprehensive model of well-being in LDCs.

Time and the Temporally Changing Effects of Growth

Since LDCs have changed greatly in recent decades, it would be valuable to revisit previous analyses with data on the 1980s and 1990s. Writing in the early 1990s and analyzing change from the 1960s to 1980s, Firebaugh and Beck (1994: 647) concluded: “The role of economic growth in bettering the human condition is a defining issue of our era.” The era from the 1980s to 2003 has been very different from the era from the mid-1960s to the mid-1980s, and has witnessed the explosion of the AIDS and debt crises, the decline of polio, the collapse of state socialism, and a wide variety of global changes. Nevertheless, Firebaugh (2003: 4) recently asserted, “The growth in per capita income is the defining feature of our historical epoch.” Given these bold claims, despite global changes in recent decades, a reexamination of the centrality of growth in the contemporary era is justified (Preston 1996).

Specifically, it is useful to ask whether the effects of growth have changed over time. Returning to Goesling and Firebaugh’s (2004) finding that in the 1990s, global

[11] Some readers might be skeptical that one can sort out the influence of these factors from each other and/or from the effect of GDP. As we go to great lengths to show below, these variables are sufficiently independent that collinearity is not a serious problem. Indeed, omitted variable bias is more problematic than any potential collinearity or endogeneity.

health inequality grew while global income inequality shrunk; it is reasonable to ask whether the relationship between growth and population health has been constant or time-varying. While the initial wave of development that occurred after decolonization from the 1960s to the 1980s might have had clear positive effects for well-being, we do not really know if the relationship changed from the 1980s to today. Continued growth might have diminishing returns for some LDCs, after they took that massive step forward in population health from the 1960s to 1980s (Bradshaw and Wallace 1996).

Another advantage of a multiyear (vs. two time point) approach is that it allows for the control of time trends. The upward global trend in population health has been so well-documented by demographers (Preston 1996) that year variables are commonplace in analyses of life expectancy and mortality (Beckfield 2004; Pritchett and Summers 1996).[12] Much of that upward trending is due to global campaigns to improve health in LDCs—e.g., the international diffusion of oral rehydration therapy to fight malaria and diarrhea, and the infant death that results (Preston 1996: 533). The spread of technology and medicine, two difficult-to-measure phenomena, also contribute to the global improvement of health (Gortmaker and Wise 1997; Preston 1975b). Since both GDP and health are upwardly trending, the association between the two might be spurious. Hence, a control for year and multiple time points are advantageous for scrutinizing such relationships.

Materials and Methods

Our analyses include 109 LDCs, with observations for 1980, 1985, 1990, 1995, 2000, and 2003.[13] A list of the countries in the sample for each dependent variable is provided in Appendix II. Using the country-year as the unit of analysis, the total number of cases varies from 508 to 587, depending on missing observations. To be included in our sample, a country had to have a real per capita GDP of less than $5,000 and a population of 500,000 in 1980, and data had to be available for at least two time points. Because of missing data, the panels are unbalanced. However, as we show in Appendix I, balancing the panel does not alter our conclusions. Also, our conclusions are consistent in Firebaugh and Beck's sample of 62 countries; in samples comprising only the poorer half of the sample; excluding former communist or Sub-Saharan African countries; the most recent cross section; or with alternative specifications (see Appendix I).

[12] Using a sample of LDCs and five-year time points from 1960–1985, Pritchett and Summers (1996: 852–853) show significant effects of year dummies. After controls, infant mortality fell 5% every 5 years.

[13] We disagree with claims that panels like ours are an apparent population rather than a sample. The population should be viewed as all country-years between 1980 and 2003 (assuming 130 LDCs, this works out to roughly 3,120 possible cases). Our sample of 587 cases is roughly 19% of that population. We sample by choosing the intervals of 1980, 1985...2003 as opposed to all years, and we sample by choosing all countries that have data for at least two time points. Moreover, these data reflect sample statistics that estimate a population parameter (e.g., life expectancy) and were sampled at various points during a given year. As Bollen (1995) argues, more data can always be collected and what seems like a population is really the hidden compilation of sampling at various stages.

Dependent Variables

We include five measures of well-being. First, *average calories* are measured as the per capita dietary energy intake per day (FAO 2005). The remaining four are from World Bank (2005). Second, *infant survival* probability is the likelihood that an infant survives to an age of 1 year. We use Firebaugh and Beck's transformation of the infant mortality rate (infant survival probability=1- (IMR/1000)) to code this measure positively. Third, *one-to-five years survival* probability is a similar measure, although it was not analyzed by Firebaugh and Beck. We converted the under-5 mortality rate into the under-5 survival probability; then we differenced the under-5 survival probability from the infant survival probability. Hence, this measures the likelihood that a child who has survived to age 1 will survive to age 5. The fourth and fifth dependent variables are *female life expectancy* and *male life expectancy* at birth.[14]

We appreciate concerns with redundancy among dependent variables, although as we show below, there are several differences across tables (e.g., for GDP's effects). We choose to include all four of Firebaugh and Beck's dependent variables for replication purposes. We add one-to-five years survival because, as we show below, the results for infant survival were so intriguing. Another child health measure is valuable to scrutinize the notable departures for the effects of GDP. Still, we acknowledge that the dependent variables are highly correlated with each other.[15]

While each dependent variable is valuable, infant and one-to-five years survival are paramount. First, these measures are less vulnerable to domination by the wealthy where the affluent pull up the average (Firebaugh and Beck 1994: 640). By contrast, average calories are only modestly associated with child hunger and thus are more socioeconomically skewed (Jenkins and Scanlan 2001). Second, the child measures are less likely to suffer from reverse causality with GDP (Pritchett and Summers 1996). The possible reverse causality between average calories and life expectancy and growth is likely to bias the coefficients for growth upwards. Third, most conclude that the child health measures have less measurement error than the others. Pritchett and Summers (1996: 858) explain, "As a pure measurement issue, the data on life expectancy are much more tenuous than those on infant or child mortality."

One common strategy in this area is to log the dependent and/or independent variables. We chose not to do so for three reasons.[16] First, the motivation for logging variables is to reduce skew, but an advantage of our larger sample is that skew is less

[14] Firebaugh and Beck examined female and male life expectancy at age 1—"to avoid redundancy with the infant survival probability" (p.640). However, the World Bank provides data on life expectancy at birth. We would lose many cases if we recalculate life expectancy from age 1. Moreover, as we show below, since the results for life expectancy and the child mortality are quite divergent, we are not concerned by the redundancy between life expectancy and child mortality.

[15] The bivariate correlations range from 0.63 between average calories and one-to-five years survival, to 0.93 between female life expectancy and male life expectancy.

[16] Appendix I shows that BIC′ very strongly prefers our models over models with the natural log of all variables for 4 of 5 dependent variables.

of a concern.[17] Second, logging has the consequence of compressing and minimizing the observed empirical variation. For example, the coefficient of variation for GDP per capita would be nearly eight times smaller if the natural log is used instead of the actual values (0.873 vs. 0.11). Growth should be able to explain the actual (and realistically) wide variation in well-being across LDCs, rather than needing to logarithmically transform the data. Third, while a curvilinear relationship might be expected in a sample of all countries, this pattern is less clear in a sample of only LDCs. The bivariate association between GDP and well-being is steeply positive at first, and flattens out for the moderately and more affluent countries (Pritchett and Summers 1996). Among LDCs, GDP should have linear positive effects (Firebaugh and Beck 1994), so a log transformation should not be necessary.

Independent Variables

Because we take Firebaugh and Beck as a point of departure, our models begin with their 5 predictors. First, real *gross domestic product* per capita is measured in purchasing power parity dollars (World Bank 2005).[18] Second, *secondary schooling* enrollment is measured as a percent of age appropriate children (World Bank 2005). Third, *inward foreign direct investment* stock is measured as a percent of GDP (UNCTAD 2005).[19] Fourth, we include *exports* as a percent of GDP (World Bank 2005). Fifth, *raw materials exports* as a percent of exports is measured with the following formula multiplied by 100: [(primary products exports+resource based products exports)—oil and gas exports]/total exports. Thus, we replicate Firebaugh and Beck's raw materials exports measure using Sanjaya Lall's (2000) classification of products.

We add five new variables. First, *fertility* is the total fertility rate (United Nations 2005). Second, *urbanization* is measured as a percent of the population (World Bank 2005). Third, *debt service* is calculated with the World Bank's (2005) estimates as a percent of gross national income.[20] Fourth, we include *year* (1980=0, 1985=1, ... 2003=6). Fifth, we constructed an *interaction of GDP and year* with the GDP variable above.

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[17] In our sample, the only variables that have high skew values are debt service and inward FDI. While this might contribute to those variables' insignificance below, logging them does not change any of our conclusions.

[18] Firebaugh (1999) persuasively argues that purchasing power parity dollars are best for comparing LDCs, but Firebaugh and Beck used exchange rate standardized dollars. Firebaugh (1999) used the Penn World Tables, while we use the World Bank data. We do so because the Penn data stop in 2000, and have considerably more missing cases. Appendix I shows that if we substitute the Penn data, our conclusions would be consistent, but BIC′ strongly prefers the World Bank models.

[19] We replicated our models while substituting FDI flows for FDI stock and the conclusions were consistent.

[20] We experimented with several measures of debt: debt as a percent of GDP or exports, debt service as a percent of exports, and Przeworski and Vreeland's (2000) measure of International Monetary Fund agreements. None of these was ever significant, so we present the debt service measure, which is straightforward and available most consistently.

Appendix I contains descriptive statistics. Since the N changes slightly across dependent variables, we report descriptives for each.

To test for collinearity, we estimated models of each independent variable regressed on all other independent variables (we also considered bivariate correlations). Appendix I displays these models. Like variance inflation factors, the fit of each model shows how much an independent variable's variation is accounted for by other independent variables. Only one variable has an R^2 that exceeds even 0.7: secondary schooling. As the results show below, this does not prevent secondary schooling from having strong effects. The models of GDP and fertility also fit well, but the R^2 shows that their unique influence can be captured in a multivariate model. Appendix I provides a correlation matrix of variables for further comparison.

We conducted tests for endogeneity bias for GDP and fertility (the two variables we suspect are most vulnerable). Endogeneity bias can result from a reciprocal relationship between a dependent variable(s) and an independent variable. The endogeneity test is conducted by (1) regressing GDP on the other independent variables, (2) saving the residuals, and (3) entering the residuals into the regression of the original dependent variable (Wooldridge 2002: 506). The coefficient for the residuals failed to reach significance for any of the five dependent variables, which suggests that endogeneity bias is not a serious problem in these models. For fertility also, the endogeneity tests failed to reach significance for any dependent variable, suggesting that endogeneity bias is not a problem.

Estimation Technique

One contribution of Firebaugh and Beck was to advocate for difference models over the semi-difference models that predominated in development sociology. Semi-difference models typically regress a dependent variable at time *t* on a set of independent variables and the dependent variable at time *t-1*. They showed that these models are vulnerable to omitted variable bias and cannot capture stable, unobserved differences among countries. They also advocated for difference models because stable, unobserved characteristics of countries drop out in difference models. We agree that difference models are superior to semi-difference models, but difference models are not the only defensible strategy. As they wrote: "The difference model is not a panacea" (1994: 648). Panel models incorporating more than two years of data offer another useful alternative to semi-difference models (Pritchett and Summers 1996).[21] Panel models incorporate greater historical variation, while simultaneously addressing Firebaugh and Beck's concerns with unobserved, stable characteristics.

As stated above, our sample is composed of a maximum of 109 countries and 580 observations. The panel is unbalanced, with some countries contributing more time points than others—although all have at least two time points. For this kind of data, a variety of panel techniques exist (Hsiao 2003). For theoretical and methodological

[21] Firebaugh and Beck (1994: 636) generally endorse panel models: "We argue that the use of panel data is appropriate for the questions raised by dependency theory, but the particular method used in dependency research is suspect."

reasons, we utilize random effects models with a first-order temporal autocorrelation correction (RE-AR1, estimated in Stata). RE-AR1 models control for unobserved, stable characteristics with a country-specific error term. RE-AR1 models, unlike fixed effects (FE or FE-AR1) models and difference models, incorporate *both* the essential cross-national and historical variation (Beck 2001; Beck and Katz 2001; Greene 1990: 495; Hsiao 2003).[22] The number of countries (109) far exceeds the number of time points (up to 6) and the cross-national variation is much larger than historical variation.[23] Difference or FE models would dispose of all the cross-national variation and only model the within-country over-time variation. The cross-national (between-) variation arguably is more important than the historical (within-) variation, and models should allow the independent variables to explain both types of variation.[24] Nevertheless, we replicated all main models with difference, FE, and FE-AR1 models and a variety of other techniques and our conclusions were consistent (see Appendix I).

The Bayesian Information Criterion Prime (BIC) assists model selection. BIC′ prefers the more parsimonious model unless fit is significantly enhanced (Raftery 1995). This allows us to assess the explanatory value contributed by the covariates we add to the Firebaugh and Beck model. Specifically, larger negative values of BIC′ indicate better fit. A BIC′ difference of 0–2 offers weak evidence for model selection; 2–6 offers positive evidence; 6–10 offers strong evidence; and greater than 10 offers very strong evidence. We note at the outset that BIC′ supports our modeling; measurement and sampling strategies—including the choice of RE-AR1 (see Appendix I).[25]

[22] Fixed effects (FE) models and difference models explain historical variation *within* countries while removing the variation between countries. FE models perform OLS after including country-specific constants and subtracting all variables from their country-specific means. Between-effects (BE) models (and OLS of one cross section) explain the *between*-country variation while removing the variation within countries. The RE model is the matrix-weighted average of the within- (FE) and between-countries (BE) estimators (Greene 1990: 488; Hsiao 2003). RE models include a country-specific error term in addition to the general error term and, subtract a portion of the country-specific means. Cross-national differences in GDP and well-being are not constant over time, but relative stability exists in the cross-national ranking of countries for these variables — hence, FE and difference models effectively mask this crucial variation (Beck and Katz 2001: 487, 492). Further, trends are essential as well, and unfortunately, BE (and one time point cross section) models mask this essential within-country variation.

[23] For every variable except one (including all dependent variables, excepting debt service), the standard deviation between countries is much more than twice as large as the standard deviation within countries.

[24] In an earlier article, Firebaugh endorses our decision to preserve the cross-national variation. Comparing models of cross-national and historical variation, Firebaugh (1980: 342) writes, “This issue may be stated as follows: does covariance over time or covariance across nations better capture the underlying causal process? Determining which covariance is more appropriate is a theoretical question, not a methodological one. In short, the question of whether to use cross-national or historical methods in comparative study must be determined ultimately by theoretical considerations, not by methodological fiat.” Our RE-AR1 models include both cross-national and historical variation.

[25] Only one alternative in Appendix I is preferred over the main models we present. This alternative would be an RE-AR1 model with the same variables, but also including regional dummies. Despite the virtues of such models, we chose to confine it to Appendix I since we want our results to be comparable with Firebaugh and Beck. Regardless, none of our conclusions would be different with this alternative specification.

In the tables below, we present unstandardized coefficients, and standardized coefficients (*betas*) to show the magnitude of effects. We present several models for each dependent variable. First, we include only GDP. Second, we replicate Firebaugh and Beck's models including GDP, secondary schooling, inward FDI, exports, and raw materials exports. Third, we add fertility, urbanization, and debt service. Fourth, we add year. Finally, we include an interaction of GDP and year. After the main analyses, we briefly discuss an array of sensitivity analyses.

Results

Average Calories

The first model in Table 1 shows that GDP has a large, significant, positive effect in the bivariate model. For a standard deviation increase in GDP, average calories are expected to increase by about 0.48 standard deviations. The second model shows that after including Firebaugh and Beck's controls, the effect of GDP is smaller (beta= 0.36) but still significantly positive. Secondary schooling and inward FDI are also significantly positive, while raw materials exports is significantly negative. The standardized coefficient (beta) for secondary schooling is not quite as large as GDP, but is sizable at 0.22. Inward FDI's positive effect contradicts dependency theory, but raw materials exports' negative effect supports dependency accounts. Regardless, the betas of both dependency variables are small. In short, the second model supports Firebaugh and Beck's conclusion that GDP is most beneficial to lifting the well-being of LDCs. BIC′ very strongly prefers Model 2 to Model 1, but does not distinguish among Models 2–5.

The third model shows that fertility has a significant negative effect, urbanization has a significant positive effect and debt service has no effect. GDP remains significantly positive with the largest effect, closely followed in magnitude by fertility and urbanization. Secondary schooling is now insignificant. Inward FDI remains significantly positive and is robust through the remaining models. Exports and raw materials exports would be significantly negative at the 0.10 level in this and the remaining models, yet with smaller effects.[26] Since inward FDI is significantly positive and the trade variables and debt service are not significant, dependency theory receives no support.

The fourth model shows that year has a significant negative effect. Since controlling for the other variables accounts for the global rise of average calories, there was a net decline in average calories. The effects of the other variables are consistent after controlling for year with one exception. Fertility now has the largest beta by a slight margin. For a standard deviation decline in fertility or increase in GDP, average calories should increase about 0.29 or 0.27 standard deviations.

The final model reveals that GDP has become less effective over time at increasing average calories. The interaction of GDP and year is significantly negative. Thus, the effect of GDP reflects a positive main effect and a subsequent

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[26] As Appendix I reveals, the fit of the models predicting the dependency measures is far too weak to suggest collinearity is a problem and that their independent effects cannot be discerned.

Table 1 Random effects models of average calories on GDP and other variables in less-developed countries, 1980–2003

	Model 1	Model 2	Model 3	Model 4	Model 5
Real GDP Per Capita PPP	0.066*	0.049*	0.039*	0.037*	0.052*
	0.479	***0.358***	***0.285***	***0.268***	***0.382***
	(11.29)	(7.64)	(6.01)	(5.61)	(5.62)
Secondary School Enrollment		3.293*	0.618	0.664	0.878
		0.222	***0.042***	***0.045***	***0.059***
		(4.98)	(0.80)	(0.86)	(1.14)
Inward FDI Stock as % of GDP		0.559**	0.466***	0.553**	0.544**
		0.090	***0.075***	***0.089***	***0.088***
		(2.98)	(2.56)	(2.98)	(2.95)
Exports as % of GDP		−0.642	−1.288	−1.257	−1.228
		−0.028	***−0.056***	***−0.054***	***−0.053***
		(−0.90)	(−1.81)	(−1.77)	(−1.74)
Raw Materials as % of Exports		−1.110*	−0.763	−0.821	−0.746
		−0.076	***−0.052***	***−0.056***	***−0.051***
		(−2.44)	(−1.72)	(−1.85)	(−1.68)
Total Fertility Rate			−49.987*	−65.337*	−63.020*
			−0.221	***−0.288***	***−0.278***
			(−3.92)	(−4.47)	(−4.32)
Urbanization			4.261**	4.533**	3.967**
			0.205	***0.218***	***0.191***
			(3.17)	(3.37)	(2.91)
Debt Service as % of GNI			−0.450	−0.349	−0.011
			−0.006	***−0.005***	***−0.000***
			(−0.36)	(−0.28)	(−0.01)
Year				−14.465*	0.742
				−0.055	***0.003***
				(−2.13)	(0.08)
Real GDP Per Capita PPP * Year					−0.004***
					−0.119
					(−2.35)
Constant	2,244.638*	2,205.255*	2,408.760*	2,507.631*	2,448.430*
	(63.57)	(40.15)	(20.58)	(19.96)	(19.21)
R^2 Within	0.064	0.144	0.198	0.200	0.217
R^2 Between	0.525	0.596	0.601	0.603	0.607
R^2 Overall	0.463	0.535	0.550	0.554	0.559
BIC′	−353.932	−412.800	−411.844	−410.656	−411.353

*$p<0.001$, **$p<0.01$, ***$p<0.05$ (two-tailed tests)

Each cell contains the unstandarized coefficient, ***standardized coefficient*** in bold and italics, and *t*-scores in parentheses. Each model contains a first-order serial autocorrelation correction. The N is 580 with 108 countries.

reduction in that effect with each successive time point. Growth may increase average calories, but it is becoming less effective at doing so over time. Fertility and urbanization remain significant with sizable effects. Because the main effect of GDP is larger, one could conclude it has a larger effect than fertility and urbanization, but this neglects its significant negative interaction with year. Last, inward FDI remains significantly positive, but years main effect is insignificant as is secondary schooling and debt service.

Infant Survival

Table 2's first model shows that GDP has a significant positive effect on infant survival. Interestingly, its beta is considerably smaller than for average calories in Model 1 of Table 1. For a standard deviation increase in GDP, infant survival is expected to increase by about 0.25 standard deviations. After including Firebaugh and Beck's controls in the second models, GDP continues to be significantly positive, but its beta is about half as large. Secondary schooling has a significant positive effect that is more than three times larger in magnitude. Exports have a

Table 2 Random effects models of infant survival probability on GDP and other variables in less-developed countries, 1980–2003

	Model 1	Model 2	Model 3	Model 4	Model 5
Real GDP Per Capita PPP	3.0 E-6*	1.5 E-6*	5.5 E-7	4.9 E-7	1.5 E-6**
	0.253	***0.124***	***0.046***	***0.041***	***0.126***
	(7.16)	(3.65)	(1.65)	(1.54)	(3.24)
Secondary School Enrollment		0.001*	0.0002*	0.0002*	0.0002*
		0.383	***0.143***	***0.121***	***0.126***
		(11.99)	(4.94)	(4.43)	(4.65)
Inward FDI Stock as % of GDP		5.8 E-6	−9.4 E-6	−0.00001	−0.00001
		0.010	***−0.016***	***−0.020***	***−0.020***
		(0.46)	(−0.94)	(−1.17)	(−1.18)
Exports as % of GDP		0.0001**	−1.2 E-6	−1.6 E-6	−2.5 E-7
		0.062	***−0.001***	***−0.001***	***−0.000***
		(2.70)	(−0.03)	(−0.05)	(−0.01)
Raw Materials as % of Exports		−0.0001	−2.2 E-6	2.2 E-6	5.6 E-6
		−0.037	***−0.002***	***0.002***	***0.004***
		(−1.86)	(−0.10)	(0.10)	(0.26)
Total Fertility Rate			−0.009*	−0.007*	−0.007*
			−0.412	***−0.329***	***−0.320***
			(−11.98)	(−7.94)	(−7.78)
Urbanization			0.001*	0.001*	0.001*
			0.288	***0.309***	***0.286***
			(6.39)	(6.31)	(5.78)
Debt Service as % of GNI			7.8 E-6	9.1 E-6	0.00002
			0.001	***0.001***	***0.002***
			(0.14)	(0.17)	(0.36)
Year				0.001**	0.002*
				0.039	***0.081***
				(2.38)	(3.79)
Real GDP Per Capita PPP *Year					−2.6 E-7**
					−0.090
					(−2.98)
Constant	0.924*	0.901*	0.937*	0.925*	0.922*
	(266.77)	(221.24)	(129.96)	(116.93)	(116.24)
R^2 Within	0.037	0.353	0.596	0.610	0.629
R^2 Between	0.552	0.712	0.783	0.763	0.767
R^2 Overall	0.486	0.679	0.768	0.749	0.754
BIC′	−332.889	−548.348	−695.024	−649.068	−652.063

*p<0.001, **p<0.01, ***p<0.05 (two-tailed tests)

Each cell contains the unstandarized coefficient, ***standardized coefficient*** in bold and italics, and t-scores in parentheses. Each model contains a first-order serial autocorrelation correction. The N is 510 with 109 countries.

modest, significant positive effect and raw materials exports has a near significant, smaller negative effect. BIC′ very strongly prefers the second model over the first.

With the inclusion of fertility, urbanization, and debt service in Model 3, GDP becomes insignificant. GDP's effect is still positive and near significant, but its beta would be about one-third the size of its beta in Model 2.[27] More importantly, the betas for secondary schooling, fertility, and urbanization dwarf GDP's beta. Though secondary schooling's effect is much smaller than in Model 2, it remains significantly positive. Fertility (−) and urbanization (+) have the largest significant effects in the model. Fertility's effect is about nine times larger than the near significant effect of GDP, and urbanization's effect is about 6 times larger. For a standard deviation increase in fertility, infant survival is expected to decline by about 0.41 standard deviations.[28] For a standard deviation increase in urbanization, infant survival is expected to increase by about 0.29 standard deviations. None of the four dependency measures significantly influences infant survival in this or the remaining models. BIC′ very strongly prefers this third model to all other models in Table 2. The dramatic improvement in BIC′ provides evidence that the effects of fertility, urbanization, and secondary schooling are not simply masking the indirect effect of GDP. If that were the case, one would not observe such a noticeable improvement in fit.[29]

The fourth model shows that year is significantly and positively associated with infant survival. There has been a significant trend of increasing infant survival that cannot be accounted for by the independent variables. Net of the other variables, infant survival is expected to increase by about 0.04 standard deviations for each time point. This finding suggests that one must control for this global trend of increasing infant health or risk overestimating the effects of the independent variables. Still, the significant variables in the third model remain significant in this fourth model, but the effects of secondary schooling and fertility are moderately smaller and the effect of urbanization is moderately larger. As in the third model, GDP is not significant. GDP remains positive, but its beta and t-score are even smaller.

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[27] Pritchett and Summers (1996) execute a variety of sophisticated techniques to report a significant effect of GDP for infant mortality, but they only control for years of schooling and year dummies. Our results suggest that all of their sophisticated techniques cannot substitute for a more complete model specification. These results suggest that their reported significant effects may be due to omitted variable bias (see also Appendix I).

[28] Fertility has such large effects partly because it is linked with infant survival in the demographic transition. Infant survival also influences fertility. This relationship is complicated though hardly overpowering (e.g., the replacement effect is stronger in poorer societies and families, [Preston 1975a; Heuveline 2001; Bongaarts and Watkins 1996]), and any reverse causality is no worse than the reverse causality between average calories or life expectancy and GDP (Pritchett and Summers 1996). Also, see the discussion of the endogeneity test above.

[29] Since GDP significantly influences secondary schooling and urbanization in Appendix I and those two influence infant survival in Table 2, one could conclude that GDP influences infant survival indirectly. However, GDP would have a very small indirect effect for infant or one to five years survival. In Appendix I, GDP has a moderate effect on secondary schooling (beta=0.2) and a very small effect on urbanization (beta=0.053). Multiplying those betas by the betas of secondary schooling and urbanization for infant survival (Table 2), GDP's standardized indirect effect would be 0.024 through secondary schooling and 0.016 through urbanization. Setting aside the assumptions in these path analyses, the growth consensus has never advocated that GDP simply has indirect, small or conditional effects.

The final model shows that GDP has become less effective over time at improving infant survival. The interaction of GDP and year is significantly negative, while year is significantly positive. Upon controlling for this interaction, GDP has a significant positive main effect. GDP increases infant survival probability but it became less effective over time and, as a result, probably has no effect after the first few time points. In this final model, secondary schooling has an equally large effect as the main effect of GDP and larger than year. Fertility and urbanization continue to have the largest effects in the model (more than twice as large as GDP).

One-to-five Years Survival

Model 1 in Table 3 displays a significant positive effect of GDP for one-to-five years survival. Despite its significance, GDP has a much smaller effect for this dependent variable (beta=0.15) compared to average calories and even infant survival. The second model with Firebaugh and Beck's controls, however, shows that this effect is not robust. In the second model, GDP would be significant only at the 0.10 level and its beta is about 0.06. By contrast, secondary schooling and exports are significantly positive while raw materials exports are nearly significantly negative. The effect of secondary schooling is about five times as large as the effect of GDP, while the effect of exports is comparable to GDP's effect. BIC′ very strongly prefers the second model over the first.

The third model demonstrates that GDP has no effect, while secondary schooling, fertility, and urbanization have significant effects. In this model, none of the dependency measures is significant. With the additional controls, secondary schooling has a much smaller effect (beta 0.13). Conversely, fertility and urbanization have much larger effects. With a standard deviation decline in fertility, one-to-five years survival is expected to increase by about 0.29 standard deviations. With a standard deviation increase in urbanization, one-to-five survival is expected to increase by about 0.32 standard deviations. Again, the dramatic improvement in BIC′ from Models 1–3 demonstrates that the effects of these variables cannot simply be masking the indirect effect of GDP.

The fourth model reveals that year is not significantly associated with one-to-five years survival net of the controls. After controlling for these predictors, there is no trend in one-to-five years survival. The effects of secondary schooling and fertility are modestly smaller and the effect of urbanization is modestly larger. The other variables are relatively unchanged and BIC′ very strongly prefers Model 3 over this model.

The final model illustrates that the insignificant effect of GDP in Models 2–4 conceals a more complicated effect. GDP has a significant positive effect when the interaction of year and GDP is included. GDP's beta is comparable to secondary schooling (betas ~.12) and year has a significant positive effect. However, the interaction of GDP and year is significantly negative. Though GDP has a positive effect, it became less effective with each successive time point, disappears by 1985, and remains null thereafter. With some fluctuation in magnitude, fertility and urbanization continue to have significant effects that are more than twice as large as GDP's effect. Ultimately, fertility, urbanization, and secondary schooling have more

Table 3 Random effects models of 1–5 years survival probability on GDP and other variables in less-developed countries, 1980–2003

	Model 1	Model 2	Model 3	Model 4	Model 5
Real GDP Per Capita PPP	1.4 E-6*	5.8 E-7	3.4 E-8	2.3 E-8	1.1 E-6**
	0.148	***0.062***	***0.004***	***0.002***	***0.118***
	(4.69)	(1.95)	(0.13)	(0.09)	(3.09)
Secondary School Enrollment		0.0003*	0.0001*	0.0001*	0.0001*
		0.312	***0.128***	***0.108***	***0.115***
		(10.33)	(4.36)	(3.90)	(4.21)
Inward FDI Stock as % of GDP		1.8 E-6	−0.00001	−5.7 E-6	−5.6 E-6
		0.004	***−0.023***	***−0.013***	***−0.013***
		(0.20)	(−1.31)	(−0.76)	(−0.76)
Exports as % of GDP		0.0001***	−1.1 E-6	−1.4 E-6	2.8 E-7
		0.045	***−0.001***	***−0.001***	***0.000***
		(2.18)	(−0.04)	(−0.05)	(0.01)
Raw Materials as % of Exports		−0.00003	−8.5 E-7	9.1 E-7	4.7 E-6
		−0.031	***−0.001***	***0.001***	***0.004***
		(−1.66)	(−0.05)	(0.06)	(0.29)
Total Fertility Rate			−0.005*	−0.005*	−0.004*
			−0.288	***−0.267***	***−0.254***
			(−8.20)	(−6.31)	(−6.11)
Urbanization			0.0005*	0.001*	0.0005*
			0.318	***0.349***	***0.316***
			(6.74)	(6.93)	(6.25)
Debt Service as % of GNI			−0.00001	−5.6 E-6	4.5 E-6
			−0.002	***−0.001***	***0.001***
			(−0.28)	(−0.14)	(0.11)
Year				−0.0001	0.001***
				−0.004	***0.054***
				(−0.26)	(2.52)
Real GDP Per Capita PPP * Year					−2.7 E-7*
					−0.122
					(−4.13)
Constant	0.963*	0.948*	0.960*	0.957*	0.954*
	(351.24)	(307.03)	(167.06)	(154.31)	(154.75)
R^2 Within	0.015	0.251	0.443	0.443	0.489
R^2 Between	0.399	0.652	0.704	0.681	0.688
R^2 Overall	0.367	0.615	0.688	0.668	0.676
BIC′	−225.910	−453.344	−541.525	−504.669	−510.374

*$p<0.001$, **$p<0.01$, ***$p<0.05$ (two-tailed tests)

Each cell contains the unstandarized coefficient, ***standardized coefficient*** in bold and italics, and t-scores in parentheses. Each model contains a first-order serial autocorrelation correction. The N is 508 with 109 countries.

powerful effects on one-to-five years survival than GDP. Despite the significant interaction effect, BIC′ very strongly prefers Model 3 over Model 5.[30]

Female Life Expectancy

The first bivariate model in Table 4 reveals that GDP has a significant positive effect. The beta is comparable to the effect of GDP on infant survival, but smaller than the

[30] Some prefer the under-5 survival to our two measures, but the results are consistent with that alternative.

Table 4 Random effects models of female life expectancy on GDP and other variables in less-developed countries, 1980–2003

	Model 1	Model 2	Model 3	Model 4	Model 5
Real GDP Per Capita PPP	0.001*	0.001*	0.001*	0.0005*	0.0003***
	0.263	***0.196***	***0.151***	***0.131***	***0.100***
	(9.02)	(6.56)	(5.21)	(4.70)	(2.40)
Secondary School Enrollment		0.122*	0.071*	0.075*	0.074*
		0.303	***0.151***	***0.187***	***0.184***
		(10.90)	(5.83)	(6.40)	(6.29)
Inward FDI Stock as % of GDP		−0.006	−0.009**	−0.005	−0.005
		−0.036	***−0.054***	***−0.028***	***−0.028***
		(−1.90)	(−3.00)	(−1.59)	(−1.60)
Exports as % of GDP		0.022***	0.003	0.002	0.002
		0.040	***0.005***	***0.004***	***0.004***
		(1.99)	(0.26)	(0.23)	(0.22)
Raw Materials as % of Exports		−0.009	−0.001	−0.003	−0.003
		−0.022	***−0.002***	***−0.007***	***−0.008***
		(−1.23)	(−0.09)	(−0.44)	(−0.50)
Total Fertility Rate			−1.344*	−2.255*	−2.268*
			−0.220	***−0.369***	***−0.371***
			(−6.08)	(−9.16)	(−9.20)
Urbanization			0.107*	0.121*	0.125*
			0.196	***0.221***	***0.229***
			(4.34)	(5.11)	(5.21)
Debt Service as % of GNI			0.006	0.011	0.010
			0.003	***0.005***	***0.005***
			(0.34)	(0.65)	(0.56)
Year				−0.814*	−0.919*
				−0.131	***−0.128***
				(−7.07)	(−5.87)
Real GDP Per Capita PPP * Year					0.00003
					0.031
					(1.00)
Constant	59.670*	54.200*	58.467*	64.022*	64.373*
	(68.22)	(54.51)	(28.62)	(30.49)	(30.23)
R^2 Within	0.087	0.206	0.212	0.206	0.207
R^2 Between	0.471	0.738	0.794	0.817	0.817
R^2 Overall	0.443	0.683	0.745	0.778	0.779
BIC′	−337.448	−643.058	−749.981	−827.164	−821.319

*$p<0.001$, **$p<0.01$, ***$p<0.05$ (two-tailed tests)

Each cell contains the unstandarized coefficient, ***standardized coefficient*** in bold and italics, and t-scores in parentheses. Each model contains a first-order serial autocorrelation correction. The N is 587 with 109 countries.

effect on average calories. With a standard deviation increase in GDP, female life expectancy is expected to increase by about 0.26 standard deviations. The second model shows that GDP continues to have a significant positive effect after adding Firebaugh and Beck’s controls, although the beta is smaller (beta=0.2). Secondary schooling has a larger positive effect (beta=0.3). Exports have a small positive effect while the other controls are insignificant. BIC′ very strongly prefers Model 2 over Model 1.

After adding the new controls in model 3, GDP continues to be significant, though its beta (0.15) is somewhat smaller. The effect of secondary schooling shrinks, but remains significant and is equal to GDP’s effect. Inward FDI now has a significant, albeit small, negative effect—although this effect is not robust in the other models. Exports, raw materials exports, and debt service are not significant. The most important variables in this model are fertility and urbanization. Fertility significantly reduces (beta=−0.22) and urbanization significantly increases female life expectancy (beta=0.2).[31] BIC′ very strongly prefers Model 3 over Model 2.

The fourth model, adding a year term, is most preferred by BIC. Year is significantly negative, which suggests that net of the controls, female life expectancy declined.[32] For each successive time point, female life expectancy is expected to decline by about 0.8. GDP, secondary schooling, fertility, and urbanization continue to have significant effects. GDP and year have the smallest significant effects (beta 0.13). Fertility has the largest effect, followed by urbanization and secondary schooling. For a standard deviation decline in fertility, female life expectancy is expected to increase by about 0.37 standard deviations. For a standard deviation increase in urbanization and secondary schooling, female life expectancy is expected to increase by about 0.22 and 0.19 standard deviations. BIC′ does not prefer the fifth model over the fourth. The significant effects in Model 4 are generally robust—with the exception that GDP’s effect is 24 percent smaller—and the interaction of GDP and year is not statistically significant.

Male Life Expectancy

Table 5’s first model shows that GDP has a significant positive effect. The beta is larger than for all dependent variables except average calories. For a standard deviation increase in GDP, male life expectancy is expected to increase by about 0.31 standard deviations. With Firebaugh and Beck’s controls in the second model, GDP remains significantly positive. As with female life expectancy, secondary schooling has a larger significant positive effect than GDP (beta 0.29 vs. 0.22). The three dependency measures are all insignificant (although exports are near significant) and remain insignificant throughout Table 5. BIC′ very strongly prefers Model 2 over Model 1.

The third model reveals that fertility and urbanization significantly influence male life expectancy. The effects of these variables are slightly larger than the effects of GDP and secondary schooling. Fertility has the largest effect (beta=−0.2) in the model, followed by urbanization (beta=0.19), GDP (beta=0.18) and secondary schooling (beta=0.17). GDP’s effect is only modestly smaller in the remaining models. Interestingly, we note that GDP’s effects are consistently larger for male life expectancy than for female life expectancy, while the effects of education and

[31] Since infant survival is a large component of life expectancy, much of the effect of fertility for life expectancy (male and female) may reflect the connection between fertility and infant mortality.

[32] This finding is probably indicative of Goesling and Firebaugh’s (2004) conclusion that life expectancy declined in some LDCs (especially Sub-Saharan Africa) in the 1990s because of the AIDS crisis. Since the AIDS crisis is unobserved in this model, it manifests in a negative year effect. If we drop the Sub-Saharan African countries, year does not have a significant effect on female life expectancy (t= 0.83). Unfortunately, data on AIDS are not sufficiently available such that we could include them in our models (data for prevalence is only available in 1999, and data on death rates is only available in 2001 and 2003). We hope future research can accommodate this factor.

Table 5 Random effects models of male life expectancy on GDP and other variables in less-developed countries, 1980–2003

	Model 1	Model 2	Model 3	Model 4	Model 5
Real GDP Per Capita PPP	0.001*	0.001*	0.0005*	0.001*	0.0005*
	0.307	***0.219***	***0.179***	***0.169***	***0.165***
	(10.16)	(7.13)	(5.99)	(5.73)	(3.78)
Secondary School Enrollment		0.101*	0.058*	0.061*	0.061*
		0.291	***0.168***	***0.177***	***0.177***
		(10.23)	(5.40)	(5.76)	(5.72)
Inward FDI Stock as % of GDP		−0.001	−0.003	−0.001	−0.001
		−0.005	***−0.022***	***−0.006***	***−0.006***
		(−0.24)	(−1.21)	(−0.30)	(−0.30)
Exports as % of GDP		0.016	−0.0001	−0.0004	−0.0004
		0.034	***−0.000***	***−0.001***	***−0.001***
		(1.67)	(−0.01)	(−0.04)	(−0.04)
Raw Materials as % of Exports		−0.007	−0.0001	−0.002	−0.002
		−0.020	***−0.001***	***−0.004***	***−0.005***
		(−1.11)	(−0.03)	(−0.26)	(−0.26)
Total Fertility Rate			−1.031*	−1.583*	−1.585*
			−0.196	***−0.301***	***−0.302***
			(−5.25)	(−6.97)	(−6.96)
Urbanization			0.090*	0.101*	0.102*
			0.191	***0.216***	***0.217***
			(3.89)	(4.45)	(4.39)
Debt Service as % of GNI			0.011	0.014	0.014
			0.006	***0.008***	***0.008***
			(0.73)	(0.93)	(0.91)
Year				−0.470*	−0.481**
				−0.076	***−0.078***
				(−4.48)	(−3.42)
Real GDP Per Capita PPP * Year					2.6 E-6
					0.004
					(0.12)
Constant	55.100*	50.827*	54.094*	57.022*	57.061*
	(69.58)	(56.32)	(27.11)	(29.22)	(28.87)
R^2 Within	0.111	0.252	0.287	0.284	0.284
R^2 Between	0.409	0.642	0.689	0.709	0.709
R^2 Overall	0.394	0.610	0.663	0.688	0.688
BIC′	−287.348	−521.451	−588.161	−626.334	−619.959

*p<0.001, **p<0.01, ***p<0.05 (two-tailed tests)
Each cell contains the unstandarized coefficient, ***standardized coefficient*** in bold and italics, and t-scores in parentheses. Each model contains a first-order serial autocorrelation correction. The N is 587 with 109 countries.

fertility are larger for female life expectancy (see betas in Tables 4 and 5). Debt service, like the three traditional dependency measures, is always insignificant. BIC′ very strongly prefers Model 3 over Model 2.

The fourth model adds year, which is significantly negative. Like for females, male life expectancy has declined after modeling these variables.[33] With year in the model, the effects of secondary schooling, fertility, and urbanization all increase in magnitude, while GDP's effect is modestly smaller. According to BIC′, this fourth

[33] If we drop the Sub-Saharan African countries, year is nearly significantly positive (t=1.7).

model is most preferred. For a standard deviation decline in fertility, male life expectancy should increase by about 0.3 standard deviations. For a standard deviation increase in urbanization or secondary schooling, male life expectancy should increase by about 0.22 or 0.18 standard deviations. For a standard deviation increase in GDP, male life expectancy should increase by about 0.17 standard deviations. For each successive time point, male life expectancy is expected to decline by about 0.4 - about half the expected decline for females. The fifth model is not preferred by BIC′ and the interaction of GDP and year is not significant. Moreover, the effects of the significant covariates in Model 4 are robust with slight fluctuation. Hence, Model 4 is the preferred model of male life expectancy.

Sensitivity Analyses

Appendix I displays a wide array of sensitivity analyses. For simplicity, we present only the unstandardized coefficient for GDP and its statistical significance, and BIC′ (other details available upon request). We display BIC′ from Model 3 of the previous tables in the first row, so the reader can compare our main tables with these alternatives. As mentioned above, these alternatives mainly reinforce our conclusions and can be summarized concisely. First, only the model with region dummies is preferred by BIC′ over our main models.[34] The remaining models in Appendix I are not preferred to our main models. Second, GDP continues to have significant effects for average calories. Third, GDP has mostly insignificant results for infant survival. The only exceptions are if year dummies are substituted for linear year or in a RE-AR1 of logs model.[35] Both of these are much less preferred by BIC′. Since GDP remains insignificant in the remaining models, we maintain our conclusion that GDP does not have a robust significant effect on infant survival. Fourth, GDP has mostly insignificant effects on one-to-five years survival. The only exception is the RE-AR1 of logs model and this model is less preferred by BIC. Fifth, GDP has mostly significant effects for female and male life expectancy, but most (all except the region dummies models) models are less preferred by BIC. Moreover, GDP does not have significant effects for male life expectancy in the difference of logs models or either life expectancy measure in the OLS model of the most recent cross section.

[34] Most of the region dummies were insignificant, with these exceptions (details available upon request): Sub-Saharan Africa has a significantly lower infant survival, one-to-five survival, female and male life expectancy; the Middle East and North Africa have a significantly higher average calories and male life expectancy; Eastern Europe and Central Asia have a significantly higher infant survival and female life expectancy; and Latin America and the Caribbean have a significantly higher male and female life expectancy (East Asia as reference).

[35] Despite its anomalousness compared to other models, the significance of logged GDP in the RE-AR1 models for infant and one to five survival might vindicate Firebaugh and Beck. However, even though GDP is significant at the 0.05 level for both dependent variables, logged secondary schooling, fertility and urbanization are significant at the 0.001 level. More important, GDP's beta for infant survival and one to five survival (0.086 and 0.075) is dramatically smaller than the betas for secondary schooling (0.159 and 0.165), fertility (−0.340 and −0.186), and urbanization (0.349 and 0.384).

Discussion

Our study scrutinizes the claims of the growth consensus about the benefits of economic growth for well-being in LDCs. We reexamine GDP's effects with a larger sample of countries, more time points, an updated historical period, additional measure of well-being, additional independent variables, and a test for declining returns to GDP over time. Ultimately, we found some evidence in support of and some evidence that challenges the growth consensus.

Consistent with the growth consensus, GDP has robust significant effects on average calories, female life expectancy, and male life expectancy. After including additional controls for fertility, urbanization, debt service and year, the sizes of the effects are smaller. But GDP's effects remain significant. Also, the effect of GDP has not declined over time for female or male life expectancy. In short, growth definitely leads to improvements in these three well-being measures in LDCs. In contrast, we find little support for dependency theory. The three traditional measures of dependency (inward FDI, exports, and raw materials exports) are not robustly significant, and debt service is never significant.

Contrary to the growth consensus, GDP does not have robust effects for infant and one-to-five years survival. In a bivariate model or in a model with Firebaugh and Beck's controls, there is some evidence that GDP affects infant and one-to-five years survival. Also, a few of our sensitivity analyses support Firebaugh and Beck (see Appendix I). Yet these effects are simply not robust, as GDP becomes insignificant after adding our new controls. These insignificant results for the child health dependent variables are especially important, given our contention that these are superior measures of the well-being of the broader population in LDCs. These measures are less likely to be dominated by the affluent, less likely to suffer from reverse causality with growth, and have less measurement error. Therefore, these findings fundamentally challenge the growth consensus.

In addition, our findings challenge the growth consensus in two other ways. First, while GDP has a significant positive effect on average calories, GDP has become much less effective over time for that dependent variable as well as the child health measures. The significant interaction of GDP and year (Tables 1 and 3) demonstrates that the effect of GDP has declined in the 1980s and 1990s. There are plausible reasons for this finding, and each warrants the scrutiny of further research. Potentially, GDP's effect has declined because of high or increasing inequality, as the benefits of economic growth may be confined to upper income households while the lower income households may not experience income growth. Especially with the caloric intake dependent variable, it could be that with development a smaller share of resources are spent on food, and so there is a declining rate of return to further economic growth. With the infant and child survival dependent variables, it is possible that the GDP-child health nexus may hit a ceiling effect as most of the gains from development have already been attained. Future research can and should test which of these is most likely. Second, and most important, other factors are more influential than growth in predicting well-being in LDCs. Fertility and urbanization have much larger effects than GDP for all dependent variables except average calories. Though more comparable to GDP's effects, secondary schooling generally has a larger beta for all dependent variables except average calories. We concluded that these more powerful effects cannot simply be attributed to an indirect effect of GDP.

Since Firebaugh and Beck served as a foundation for Firebaugh's (2003) examination of global inequality, we suggest a reconsideration of his conclusion of declining global inequality. Firebaugh (2003) only analyzes income, even though Goesling and Firebaugh (2004) find global inequality in life expectancy is increasing. We argue that global inequality in well-being is paramount, and health is a more proximate indicator of well-being than income. Sen (1999) explains income is important because it is a resource for purchasing well-being, not because it is well-being. Since GDP does not have as straightforward a relationship with well-being as Firebaugh and Beck concluded, it may be premature to infer global equalization from declining global income inequality. At a minimum, even if global income inequality is narrowing, we cannot infer that global inequality in well-being is narrowing.

Perhaps the thorniest issue raised by our analysis is the possible interrelationships among variables. Because the effect of GDP only attenuates when controls are added, the growth consensus could respond that the true effect of GDP is mediated by those controls. As we display in Appendix I, GDP is associated with education and urbanization. Nevertheless, we challenge this interpretation for four reasons.

First, our study goes far beyond past studies in scrutinizing collinearity and endogeneity among the variables. GDP, education, urbanization, and fertility are sufficiently independent in our data such that the estimation of distinct, conditional effects is possible. Even controlling for differences in the levels of GDP, higher levels of education, urbanization, and fertility still positively influence well-being. Second, if education, urbanization and fertility were simply mediating GDP's effect, model fit would not improve as substantially as it does with the addition of those variables (cf. BIC).[36] Third, the growth consensus has never contended that GDP only has indirect effects whereby GDP benefits the masses by triggering urbanization and expanded education. Fourth, even if GDP has indirect effects, those effects would be far smaller than the growth consensus has claimed (see fn. 29). These last two points would still require a substantial revision to the theory and policies advocated by the growth consensus.

Our results suggest at least two directions for future research. First, education significantly affects four of the five dependent variables. There are many social changes that correlate with the expansion of schooling, and these changes are directly associated with improved well-being. Since girls are likely to be the children who are initially excluded from education, a larger expansion of schooling typically involves the widespread entrance of girls into formal schooling (Nussbaum 2004). Because of education's centrality to improved well-being in LDCs, why and how schooling expands remains a key development concern (Schafer 1999).

Second, women's status and gender equality have profound effects on well-being in LDCs (Blumberg 1995; Parpart et al. 2000). The large effect of fertility on well-being may be our most important conclusion. As Sen (1999: 226) writes, "Reducing

[36] On balance, GDP could be just as vulnerable to the charge of endogeneity. Endogenous growth theory claims education boosts GDP, so it could be that GDP is masking secondary schooling's true effect. As Appendix I shows, GDP could be endogenous to secondary schooling, exports, raw material exports, and urbanization.

fertility is important not only because of its consequences for economic prosperity, but also because of the impact of high fertility in diminishing the freedom of people—particularly of young women—to live the kind of lives they have reason to value." This is especially true since education is linked to lower fertility as well (Axinn and Barber 2001; Hannum and Buchmann 2003). As countries experience the demographic transition and high levels of fertility decline, all five dependent variables improve. This decline of fertility, like the expansion of schooling, suggests broader improvements in gender equality (Nussbaum 2000). These changes contribute directly to the improvement of millions of girls and women's lives, and indirectly trigger improvements in children's well-being (Boehmer and Williamson 1996). Partly due to the paucity of data, there is still much to learn about the causes of gender equality in LDCs (Bose and Acosta-Belen 1995; Forsythe et al. 2000). One finding of Tables 4 and 5 deserves further mention. GDP has larger effects for male life expectancy than for female life expectancy, and education and fertility have larger effects for female life expectancy than male life expectancy (see betas). If growth benefits men more, while education and declining fertility benefit women more, analysts need to consider if both sexes benefit equally from the influences on well-being in LDCs. Rather than simply asking if growth benefits well-being, we need to ask who benefits.

It would be irresponsible to suggest that the pursuit of declining fertility, rising education and urbanization are somehow mutually exclusive with the pursuit of growth. We do find that GDP does not affect fertility net of other controls (see Appendix I).[37] But, there is no evidence that growth comes at the expense of higher fertility; and GDP, education and urbanization are positively associated (see Appendix I). It is unlikely that urbanization and education simply mask the indirect effect of GDP for well-being, but it is feasible to pursue all three at the same time. However, GDP and education and urbanization are not perfectly correlated, and LDCs sometimes are forced to choose between policies aimed at expanding education (e.g., building schools, raising teacher salaries, reducing fees, etc.) and policies demanded by international agencies in pursuit of growth (e.g., privatization, fiscal austerity, lowering taxes, reducing services, etc.) (e.g., Sen's [1999: 42] contrast of India and China; Stiglitz 2002). LDCs may be better served by the former, and the shortsighted focus on growth by international agencies may be counterproductive. Sen (1999: 48–49) argues, "A country need not wait until it is much richer (through what may be a long period of economic growth) before embarking on rapid expansion of basic education and health care. The quality of life can be vastly raised, despite low incomes, through an adequate program of social services."[38] If LDCs face choices between growth and decreased fertility, LDCs

[37] We would not dispute that fertility is associated with development generally (i.e., in the demographic transition). Bongaarts and Watkins (1996) show that fertility is negatively associated with the Human Development Index (HDI). The HDI is a broader measure than GDP, and includes many of the other dimensions of development that we argue are important (e.g., education) as well as some of our dependent variables. As Heuveline (2001) shows, the link between economic development and fertility decline is complicated (see also footnote 28).

[38] It is important to acknowledge that Sen has made the point that economic growth may indirectly benefit the poor's well-being through increased public revenues. Whether such increased revenue is turned into spending for the poor is an open question. Perhaps future research can test this indirect relationship between GDP and well-being, as well as the political question of how GDP translates to differential public spending.

should pursue decreased fertility first. This point illustrates the profound contradictions of U.S. government declarations of a commitment to growth to fight deprivation in LDCs, while at the same time actively undermining family planning services. Because of the value of family planning in reducing fertility, U.S. development policy may undermine the health of children and women in LDCs.

Our study is partly motivated by the concern that growth is simply assumed to be the first priority for well-being in LDCs. Rather than accepting the assumptions of the growth consensus, it is essential to scrutinize claims about the benefits of growth. Ultimately, we encourage a reorientation away from the exclusive concentration on growth for LDCs. Of course, growth can be beneficial. But, growth is not the only, or even most important, means to improve well-being in LDCs. Development is a multidimensional process and other dimensions beside growth can be tremendously influential for lifting well-being in LDCs.

Acknowledgements We are grateful to Glenn Firebaugh for detailed and constructive comments. We thank Katy Fallon, Phil Morgan, Emilio Parrado, Jim Moody, the reviewers and editors at SCID, and especially the University of North Carolina at Charlotte's Sociology faculty and students for suggestions.

Appendix I

Table 6 Descriptive statistics: means and standard deviations in parentheses

	Average Calories	Infant Survival Probability	One to Five Years Survival Probability	Female Life Expectancy	Male Life Expectancy
Dependent Variable	2,495.434	0.939	0.970	63.103	58.703
	(436.003)	(0.043)	(0.033)	(11.821)	(10.151)
Real GDP Per Capita PPP	3,790.447	4,050.886	4,004.645	3,902.553	3,902.553
	(3,172.186)	(3,536.288)	(3,445.900)	(3,409.743)	(3,409.743)
Secondary School Enrollment	49.147	51.342	51.278	49.160	49.160
	(29.397)	(29.767)	(29.807)	(29.340)	(29.340)
Inward FDI Stock as % of GDP	22.556	24.545	24.255	23.106	23.106
	(70.088)	(73.896)	(73.879)	(70.036)	(70.036)
Exports as % of GDP	31.920	34.248	33.836	32.944	32.944
	(18.823)	(22.062)	(21.086)	(21.523)	(21.523)
Raw Materials as % of Exports	49.405	47.725	47.864	49.223	49.223
	(29.803)	(29.608)	(29.582)	(29.877)	(29.877)
Total Fertility Rate	4.381	4.188	4.198	4.364	4.364
	(1.925)	(1.929)	(1.926)	(1.933)	(1.933)
Urbanization	45.375	47.019	46.810	45.811	45.811
	(20.975)	(21.638)	(21.423)	(21.648)	(21.648)
Debt Service as % of GNI	5.797	5.554	5.576	5.751	5.751
	(5.673)	(5.687)	(5.688)	(5.682)	(5.682)
Year	2.709	2.961	2.963	2.697	2.697
	(1.648)	(1.620)	(1.620)	(1.647)	(1.647)
Real GDP Per Capita PPP * Year	10,998.060	12,621.020	12,480.800	11,325.210	11,325.210
	(13,504.920)	(15,096.920)	(14,765.320)	(14,470.020)	(14,470.020)

Table 7 Sensitivity analyses of alternative specifications and techniques

	Average Calories	Infant Survival Probability	One to Five Year Survival Probability	Female Life Expectancy	Male Life Expectancy
Model 3 BIC′ in Tables Above	−411.844	−695.024	−541.525	−749.981	−588.161
Model 4: Year Dummies Instead of Linear Year	0.037** (−384.295)	7.79E-7* (−668.487)	1.61E-7 (−532.318)	0.0005*** (−797.967)	0.0005*** (−595.031)
Model 3: Difference Models (hc3)	0.032*** (19.390)	1.27E-7 (24.405)	−1.66E-7 (27.265)	0.0003*** (19.470)	0.0005*** (−4.321)
Model 3: With Region Dummies[a]	0.041*** (−512.584)	5.52E-7 (−737.222)	−9.65E-8 (−711.813)	0.0004*** (−1,057.148)	0.0004*** (−964.210)
Model 3: GDP Growth	470.910* (−286.147)	0.001 (−553.994)	−0.006 (−457.238)	−2.254 (−613.294)	0.600 (−484.882)
Model 3: OLS of Most Recent Cross-Section (hc3)	0.041*** (−63.602)	1.06E-6 (−140.937)	−9.82E-7* (−130.523)	−0.00004 (−130.370)	−0.00008 (−99.217)
Model 3: Difference of Logs Models	0.122*** (0.455)	0.004 (5.282)	0.003 (−5.068)	0.024* (33.975)	0.021 (16.628)
Model 3: Fixed Effects w/ AR1 Models	0.033*** (−213.257)	−8.05E-7 (−14.866)	−1.04E-6 (1.762)	0.0003** (−277.685)	0.0005*** (−187.309)
Model 3: Cases Below Median Real GDP Per Capita PPP	0.186*** (−44.012)	2.22E-6 (−158.530)	1.87E-6 (−185.527)	0.001** (−295.371)	0.001** (−276.057)
Model 3: Penn World Tables Real GDP Per Capita PPP	0.044*** (−321.411)	7.31E-7 (−520.947)	8.24E-8 (−425.331)	0.0004*** (−621.326)	0.0004*** (−483.486)
Model 3: Excluding Ex-Communist Countries[b]	0.040*** (−285.678)	1.20E-07 (−480.441)	−8.71E-09 (−349.281)	0.0006*** (−503.247)	0.0005*** (−474.803)
Model 3: Excluding Sub-Saharan African Countries	0.034*** (−157.746)	3.99E-07 (−343.800)	−1.01E-07 (−290.270)	0.0003*** (−439.432)	0.0004*** (−240.276)
Model 3: Firebaugh and Beck Sample	0.040*** (−191.760)	3.03E-7 (−323.454)	3.46E-7 (−247.024)	0.0008*** (−360.479)	0.0006*** (−338.806)
Model 3: Random Effects of Logs with AR1	0.111*** (−415.735)	0.004* (−589.192)	0.003* (−457.761)	0.065*** (−693.033)	0.050*** (−569.655)

***$p<0.001$, **$p<0.01$, *$p<0.05$ (two-tailed tests)

Each cell contains the unstandardized coefficient for Real GDP Per Capita and BIC′. Other details available upon request.

[a]: The regions are Latin America and Caribbean, Middle East and North Africa, Sub-Saharan Africa, East Europe and Central Asia, South Asia, and East Asia and Pacific. The reference region is East Asia and Pacific.

[b]: If Vietnam is coded as Ex-Communist or China is not coded as Ex-Communist, the results are consistent.

Table 8 Matrix of random effects models of independent variables as dependent variables on all other independent variables

	GDP Per Capita	Secondary School Enrollment	Inward FDI	Exports	Raw Materials Exports	Fertility	Urbanization	Debt Service
Real GDP Per Capita PPP		0.002***	−0.0003	0.002***	−0.001*	−0.00001	0.0003**	−0.0001
		(5.37)	(−0.28)	(4.62)	(−2.22)	(−0.72)	(2.75)	(−0.96)
Secondary School Enrollment	26.817***		−0.064	−0.090*	−0.162*	−0.012***	0.041**	0.006
	(5.34)		(−0.39)	(−2.00)	(−2.34)	(−6.58)	(2.90)	(0.34)
Inward FDI Stock as % of GDP	−0.312	−0.004		0.034**	−0.006	0.001	0.003	0.001
	(−0.25)	(−0.36)		(3.31)	(−0.35)	(1.95)	(0.88)	(0.24)
Exports as % of GDP	17.524***	−0.077*	0.414**		−0.215**	−0.006**	0.008	0.070***
	(3.87)	(−2.07)	(2.87)		(−3.37)	(−3.35)	(0.65)	(4.50)
Raw Materials as % of Exports	−6.383*	−0.048*	−0.069	−0.091**		0.001	−0.016*	0.013
	(−2.19)	(−1.99)	(−0.74)	(−3.46)		(0.840)	(−2.02)	(1.16)
Total Fertility Rate	−135.993	−7.105***	6.738*	−2.479**	1.192		−1.907***	0.220
	(−1.32)	(9.70)	(2.11)	(−2.97)	(0.94)		(−5.61)	(0.76)
Urbanization	55.998***	0.263***	0.337	0.058	−0.125	−0.032***		0.034
	(5.95)	(3.77)	(1.20)	(0.73)	(−1.10)	(−8.14)		(1.62)
Debt Service as % of GNI	−0.049	0.012	0.063	0.296***	0.004	0.0001	−0.036	
	(−0.01)	(0.17)	(0.24)	(3.90)	(0.03)	(0.03)	(−1.82)	
Year	−121.542*	0.223	8.038***	0.159	−0.933	−0.244***	1.207***	0.071
	(−2.58)	(0.61)	(5.33)	(0.42)	(−1.61)	(−14.83)	(7.50)	(0.46)
Constant	758.230	66.434***	−49.535	41.135***	71.999***	7.192***	48.049***	1.578
	(0.86)	(10.79)	(−1.83)	(5.80)	(6.81)	(37.07)	(19.59)	(0.67)
R^2 Within	0.127	0.406	0.117	0.232	0.173	0.701	0.623	0.018
R^2 Between	0.622	0.754	0.068	0.298	0.296	0.662	0.472	0.145
R^2 Overall	0.598	0.722	0.084	0.286	0.259	0.641	0.441	0.077
BIC′	−485.271	−700.860	−1.090	−146.820	−125.401	−551.189	−291.286	4.154

***$p<0.001$, **$p<0.01$, *$p<0.05$ (two-tailed tests)

Each cell contains the unstandarized coefficient and the *t*-scores in parentheses. Each model contains a first-order serial autocorrelation correction.

Table 9 Correlation matrix of variables (N=503)

	Average Calories	Infant Survival Probability	One to Five Year Survival Probability	Female Life Expectancy	Male Life Expectancy	Real GDP Per Capita PPP	Secondary School Enrollment	Inward FDI Stock as % of GDP	Exports as % of GDP	Raw Materials as % of Exports	Total Fertility Rate	Urbanization	Debt Service as % of GNI	Year
Average Calories	1.000													
Infant Survival Probability	0.685	1.000												
One to Five Year Survival Probability	0.630	0.935	1.000											
Female Life Expectancy	0.659	0.905	0.903	1.000										
Male Life Expectancy	0.631	0.891	0.895	0.981	1.0000									
Real GDP Per Capita PPP	0.677	0.707	0.617	0.670	0.620	1.000								
Secondary School Enrollment	0.641	0.799	0.781	0.817	0.778	0.683	1.000							
Inward FDI Stock as % of GDP	0.044	−0.057	−0.171	−0.087	−0.074	−0.055	−0.046	1.000						
Exports as % of GDP	0.234	0.373	0.329	0.351	0.321	0.364	0.378	0.171	1.000					
Raw Materials as % of Exports	−0.429	−0.411	−0.403	−0.442	−0.442	−0.407	−0.488	−0.135	−0.295	1.000				

Table 9 (continued)

	Average Calories	Infant Survival Probability	One to Five Year Survival Probability	Female Life Expectancy	Male Life Expectancy	Real GDP Per Capita PPP	Secondary School Enrollment	Inward FDI Stock as % of GDP	Exports as % of GDP	Raw Materials as % of Exports	Total Fertility Rate	Urbanization	Debt Service as % of GNI	Year
Total Fertility Rate	−0.666	−0.864	−0.832	−0.844	−0.805	−0.695	−0.841	0.052	−0.356	0.460	1.000			
Urbanization	0.568	0.664	0.633	0.663	0.623	0.645	0.647	0.018	0.276	−0.347	−0.629	1.000		
Debt Service as % of GNI	0.136	0.120	0.092	0.103	0.104	0.123	0.092	0.077	0.302	−0.014	−0.084	0.186	1.000	
Year	0.131	0.245	0.190	0.124	0.134	0.114	0.272	0.142	0.175	−0.201	−0.358	0.200	0.076	1.000

Appendix II

Samples of Countries

Calorie Models: 108 Countries

Albania, Algeria, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Belarus, Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Republic, Chad, Chile, China, Colombia, Congo Democratic Republic, Congo Republic, Costa Rica, Cote d'Ivorie, Croatia, Czech Republic, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Guatemala, Guinea, Haiti, Honduras, Hungary, India, Indonesia, Iran, Jamaica, Jordan, Kazakhstan, Kenya, Kyrgyz Republic, Laos, Latvia, Lebanon, Lithuania, Macedonia, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Moldavia, Mongolia, Morocco, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Romania, Russian Federation, Rwanda, Senegal, Sierra Leone, Slovak Republic, Slovenia, South Africa, South Korea, Sri Lanka, Sudan, Syria, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, Uruguay, Uzbekistan, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe

Infant Survival, One-to-Five Survival, Female and Male Life Expectancy Models: 109 Countries

Albania, Algeria, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Belarus, Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Republic, Chad, Chile, China, Colombia, Congo Democratic Republic, Congo Republic, Costa Rica, Cote d'Ivorie, Croatia, Czech Republic, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Guatemala, Guinea, Haiti, Honduras, Hungary, India, Indonesia, Iran, Jamaica, Jordan, Kazakhstan, Kenya, Kyrgyz Republic, Laos, Latvia, Lebanon, Lithuania, Macedonia, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Moldavia, Mongolia, Morocco, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Romania, Russian Federation, Rwanda, Senegal, Sierra Leone, *Singapore*, Slovak Republic, Slovenia, South Africa, South Korea, Sri Lanka, Sudan, Syria, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, Uruguay, Uzbekistan, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe

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