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Abstract

This paper investigates whether a divergence between the biological standard of living (commonly measured by some anthropometric indicator) and GDP per capita during the early phases of industrialization, as observed for many now-developed countries in the nineteenth century, can also be found for the current developing countries. The paper examines whether such a divergence exists and which factors might explain its possible existence. We conclude that there is not much evidence for such a divergence. However, there is considerable variance of stunting across countries which can partly be explained by such factors as the infant mortality rate in addition to GDP per capita.

JEL Classification: O10, I12, N30

Key words: anthropometry, development process

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1. Introduction

Ever since Margo and Steckel (1983) first found a decline in physical stature of common people in the United States during a period when GDP per capita was thought to have increased (mid-1800s), there has been a lively discussion on the factors behind this divergence between the biological standard of living and goods-based measures of the standard of living.

The purpose of this paper is to investigate whether the 'early industrial growth puzzle'[1] also applies to the current developing countries. This puzzle refers to a sustained decline of the biological standard of living (commonly estimated as some measure of sex- and age-specific height) during early phases of economic modernization, while conventional measures such as GDP per capita increase at the same time. Komlos suggested several factors, many inherent to the process of development, which might account for this divergence (Komlos 1994a: pp. xii-xv; Komlos 1994b; Komlos 1996a). This paper will address both parts of the paradox, i.e. whether a divergence exist and whether the determinants can be identified in the context of contemporary developing countries.

[1] The name was coined by John Komlos (Komlos 1996a: p. 2). Several other, similar cases were collected and discussed by Komlos (Komlos 1994a; Komlos 1994b), and Steckel (Steckel 1995a), among others. A daring attempt to explain the early industrial growth puzzle by applying some straightforward economic theory was presented by Komlos during the *European Social Science History Conference*, held at Noordwijkerhout, The Netherlands, from 9 - 11 May, 1996 (Komlos 1996a).

The paper is organized as follows. In the first section, the evidence on and the explanations for the early industrial growth puzzle will be reviewed. The use of anthropometric indicators in developing countries will be discussed in the second section. In the following section, several factors affecting the validity of a comparison between contemporary developing and the nineteenth century of the now-developed countries are presented. Then, the particular anthropometric data set, on the stunting of children, is discussed. Finally, regression analysis is used to first determine whether there is a divergence between GDP per capita and stunting and which factors -as suggested by Komlos- can play a role in explaining the variation in stunting.

2. The early industrial growth puzzle and its possible explanation

When Margo and Steckel were the first to report in 1983 the by now famous anomaly of a marked decline in physical stature of American white men (born between 1830 and 1860) during times when the economy in which they lived must have been -according to a wealth of historical evidence- vigorously growing, it was thought of by most scholars as a standard example of the exception that confirms the rule. This changed rapidly in the years thereafter. A host of similar paradoxical findings were reported in the years that followed: for Swedish recruits, born between 1730 and 1790 (Sandberg and Steckel 1987); for Habsburg soldiers, born between 1740 and 1790 (Komlos 1989); for Bavarian males born between 1755 and 1775 (Baten 1997-forthcoming); for English and Irish soldiers in the British army between 1740 and 1790, and for English boys between 1740 and 1840 (Komlos 1993a); for boys in the Habsburg monarchy, born between the 1760s and the 1790s (Komlos 1989); for both English adult convicts and British servants in colonial North-America between 1720 and 1755; and finally for English convicts sent to Australia, between 1780 and 1800 (Nicholas and Steckel 1991; Komlos 1993b).

While all the cases cited in the previous paragraph apply to people born in the 18th century, that is, during what Komlos called the "classical phase" of the Industrial Revolution, the 'early industrial growth puzzle' became even more puzzling when it became clear that the pattern seemed to repeat itself in numerous countries somewhere during the first half the 19th century, a period that -for almost all of the countries involved- should be characterized at least as the 'neo-classical phase' in economic growth, in the sense that modernization was at that time well under its way. Both free black males and females became shorter between 1820 and 1840 (decade of birth) (Komlos 1992); the heights of young convicts (both black and white), born in the American South and convicted in Georgia went down between -at least- 1820 and 1860 (Komlos, Katzenberger and Coclanis 1995); heights of Bavarian males and females declined between the first years of the 1820s and continued to do so until the beginning of the 1840s (Baten 1997-forthcoming), and the same can be said of Scottish and Irish adult convicts, born between 1810 and 1830, in Scotland (Riggs 1994), and of middle class West Point Cadets, born between 1843 and 1858 (Komlos 1996b), although the last point was denied by the author who presented the figures.[2] Recently Drukker and Tassenaar discovered that yet another case might be added to the list: The nowadays notoriously tall Dutch conscripts, who were by the way not exceptionally tall during the first half of the 19th century, shrunk on average by more than 3 cms. between 1810 and 1837 (years of birth) (Drukker and Tassenaar 1995: Statistical Annexe, p. 1, Table 1).

Perhaps one of the most intriguing aspects of the 'early industrial growth puzzle' is the fact that some specific groups were found that became notably taller during the years that most of the people were becoming smaller. For the 'classical phase' of modern economic growth, German -upper class- students during the third quarter of the 18th century are the exception to the rule (Komlos 1990). For what we have nicknamed the 'neo-classical phase', it is clear that adult American slaves increased in height between 1820 and 1840 (Komlos, Katzenberger and Coclanis 1995; Steckel 1995b). And although Komlos wants to count also the American -middle class- students (the earlier mentioned West Point Cadets) among these exceptions, we have some reservations on this point.[3]

In 1996 Komlos tried to reconcile the disturbing and apparently contradictory findings of declining biological standards of living in periods of rising GDP per capita, during some early phase of economic modernization, by putting the then known facts together in a framework of standard economic theory, and in an admirable consistent way, he also tried to incorporate the above mentioned 'historical exceptions' to the early economic growth puzzle into his explanation. The whole of his explanation rests on no less than eleven basic arguments. According to Komlos, on the eve of economic modernization:
(1) incomes tended to become more unevenly distributed (Komlos 1996a: pp. 2-3);
(2) food prices rose, relative to the prices of other goods, due to a lagging behind of technological change and capital accumulation in agriculture, compared with industry (Komlos 1996a: pp. 3-6);
(3) the year to year variability of income of common people tended to increase (Komlos 1996a: pp. 6-7);
(4) large groups of people, who had before been living in a situation of more or less economic self sufficiency, gradually integrated into the market economy, and thus, concerning their nutritional status, became more sensitive to rising food prices (Komlos 1996a: pp. 7-9);

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2 Although there is a more than 3 per cent decline in the height of West Point Cadets between 1824 and 1858 (Komlos 1996a: Figure 15), and a steady increase afterwards until the level of the early 1820s is more or less reached again in 1875, the author concentrates for some reason only on the beginning and the end of his curve, as he writes: "... A similar pattern can be found among middle class West Point Cadets, whose height *did not diminish during the antebellum period*, as did that of the common man..." (Komlos 1996a: p. 3; italics added, HJB,JWD,BS). May be our Dutch history book was completely wrong by suggesting that the American Civil War started in 1860?

3 Cf.: note 2 to this paper, here above.

(5) population growth in itself contributed, in combination with diminishing returns to labor in the agricultural sector, to a deteriorating nutritional status (Komlos 1996a: p. 9);
(6) increased urbanization in itself led to higher food prices for a growing percentage of the population, as long as an insufficient transport technology hampered a reduction of price difference between rural and urban food prices (Komlos 1996a: p. 9);
(7) accelerated industrialization meant substantial sectoral shifts within the labor force, which in turn implied that an ever smaller number of farmers had to produce food for a steadily increasing number of industrial households (Komlos 1996a: p. 10);
(8) intensification of labor would occur, as the spread of industries would provide more opportunities for children to work in factories (Komlos 1996a: p. 10);
(9) increasing population density would, in combination with growing urbanization and a rising trade volume, created a increasingly favorable environment for transmitting diseases (Komlos 1996a: pp. 10-11).
To these eight arguments that are, so to say, built-in, endogenous or unavoidable factors accompanying the general historical process of modernization, wherever it took place in Europe or in the United States, somewhere during the second half of the 18th and the first half of the 19th century, Komlos added two other arguments of a more exogenous, or *ad-hoc* character:
(10) weather conditions worsened in Europe during the second half of the 18th century, which had a negative impact on agricultural productivity, thereby worsening the nutritional status of Europeans (Komlos 1996a: p. 10);[4]
(11) at the end of both periods of decline in the biological standard of living, major wars broke out: in Europe, the first period of declining heights culminated in the Napoleonic Wars, while the outbreak of the American Civil War marked the end of the second period of worsening material conditions (Komlos 1996a: p. 11).[5]

Given the fact that, as Komlos' explanatory scheme suggests, the majority of the factors cited above, were 'endogenous' or unavoidable by-effects of the modernization-process, the essential question arises whether the same mechanisms that caused the biological standard of living to decline during the early

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[4] As long as there is no evidence of a similar deterioration of meteorological circumstances in the United States, this factor is of no use in explaining the worsening biological standard of living of American citizens during these years. Komlos seems to ignore this point.

[5] The author himself admits that the last argument (war) cannot possibly have been a major factor in the explanantion of the declining biological standard of living, when he writes: "...Yet, the beginning of the decline in nutritional status preceeded the onset of both these conflicts, and hence could not have been caused by them. Moreover, the fact that slaves and middle class cadets born in the 1840s, who lived through the Civil War as teenagers did not decline in height is an indication that the war's impact was not general. Moreover, the fact that heights rose among the Ohio National Gueardsmen as well as among West Point Cadets born shortly after the war indicates that its impact was temporary..." (Komlos 1996a: pp. 11-12).

phase of modernization in Europe and the United States, are also at work in the contemporary world. In other words, it would be interesting to see whether the same paradoxical developments that characterized economic modernization in the Western world, can nowadays also be identified in the contemporary developing countries. This question is the central point of the rest of this paper.

3. Anthropometric indicators in developing countries

Anthropometric indicators are frequently used by international organizations, such as UNICEF and the World Health Organization (WHO), to measure different aspects of the nutrition and health situation in the developing world and to monitor progress toward goals agreed at by governments at international conferences. Different indicators are employed, each signifying different aspects of the nutrition and health situation. Low height-for-age, for instance, is used to indicate long-term cumulative inadequacies of health and nutrition (WHO 1995: p. 164). It is also recognized that these inadequacies are ultimately determined by socio-economic conditions (FAO and WHO 1992: p. 11; WHO 1995: p. 177). When low height-for-age becomes pathological, it is referred to as 'stunting'. Low weight-for-height, usually called 'wasting' when pathological, gives usually a better indication of the current health and nutrition situation as inadequate food intake and diseases very quickly translate into loss of weight among adults or failure to gain weight among children. The interpretation of weight-for-age is more difficult as it can reflect both wasting and stunting. Yet, underweight is the indicator most frequently used by international organizations to signify undernutrition.

Because the significance of stunting is wider than its nutritional meaning and its nature more endemic and less transient than the other indicators, we have used only the stunting data in this paper. By now it is generally accepted (WHO 1983: pp. 21-22; WHO 1995: p. 181) that an abnormal anthropometric value is a value of 2 standard deviations (SD) below (or 2 SD above) the median value of the reference pattern. Stunting is thus defined as height 2 SD or more below the reference median. This is also referred to as severe and moderate stunting combined, while a cut-off point of 3 standard deviations refers to severe stunting only (FAO and WHO 1992: p. 11). In this paper we employ a cut-off point of two standard deviations.[6]

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[6] These cut-off points are based on widely accepted relationships between anthropometric indicators and *inter alia* functional impairments and increased risk of morbidity and mortality (Dasgupta 1993: pp. 81-87; FAO 1996: pp. 63-64; Fogel 1994: p. 374; WHO 1995: pp. 179-180; see also: Osmani 1987). Some have found evidence that there is even a relation between adult height and the risk of morbidity and mortality at middle and late ages (Fogel 1994: pp. 374-375, 383; WHO 1995: p. 180). This last point, however, seems not to be completely uncontroversial (Dasgupta 1993: p. 83).

There is a small group of scholars who argue that people can be small but healthy. The validity of the small-but-healthy hypothesis is, however, not clear at all. There has been an extensive discussion on whether the adaption of human beings to energy stress invalidates the use of anthropometric measures of nutrition. Osmani (1987: section 3) reviewed the literature of the arguments for and the evidence on the small-but-healthy hypothesis. It should be noted first that the hypothesis only refers to mild and moderate malnutrition and that there is no disagreement on the fact that impairment of functions occur in cases of severe nutritional stress (Osmani 1987: p. 45). One of the most critical issues of the validity of the hypothesis is whether adaption is costless, i.e. whether moderately stunted people can avoid functional impairment. Osmani looked at four functions: immunocompetence, reproductive efficiency, work capacity, and cognitive development. Regarding immunocompetence and work capacity he concluded that there is no evidence suggesting that moderate stunting has a negative effect. Regarding reproductive efficiency, no conclusions can be drawn yet.[7] However, regarding cognitive development methodological problems, are (unsurmountably) large. Cognitive development is dependent on nutrition and stimuli while nutrition and stimuli are interdependent and often simultaneously deficient. Thus, sufficient nutrition allows activity, which on its turn determines the amount of stimuli a child gets. In other words, nutritional deficiencies might not directly cause any cognitive effects but they are associated with lower activity levels and the contribution of nutrition *per se* is therefore difficult, if at all, to determine. Osmani therefore argued that a distinction be made between the causative statement of the small-but-healthy hypothesis, i.e. moderate stunting does not impair any nutritional capability, and the associative statement, i.e. a moderately stunted child does not suffer from any impairment of nutritional capabilities.

Osmani concluded that "..[w]hile one cannot accept that a stunted child is necessarily healthy, neither can one go back to embrace the genetic potential theory[[8]] because the falsity of the associative statement does not imply the truth of the converse. In other words, one cannot assume a stunted child has necessarily suffered from nutrition-constrained cognitive retardation. That would depend on whether the child had actually reduced his activity at the same time that it became stunted..." (Osmani 1987: p. 67).

There are on the other hand also authors who reviewed the relevant literature and who came to much more categorical conclusions. Dasgupta and Ray, for instance, concluded that: "...*if adaptation exists, it is purchased at a cost.* The cost involves, among other things, a reduction in the capacity for sustained physical and mental activities, and a greater susceptibility to infection and disease..." (Dasgupta and Ray 1990: p. 193 -original italics-; see also: Dasgupta 1993: p. 85).

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[7] Most studies, for example, do not separate the effect of small mothers from poor nutrition during pregnancies or severely stunted mothers from moderately stunted ones.

[8] The "genetic potential theory" argues that any shortfall in an anthropometric measure from a desirable standard should be interpreted as a situation of inadequate nutrition (Osmani 1987: pp. 42-44).

We also disagree with Osmani's conclusion. Even if the small-but-healthy hypothesis were true, anthropometric measures can still be used as an indicator for a wider set of standard of living components because the necessity to adapt by way of stunting is itself an indication of some kind of deprivation (Osmani 1987: p. 95). The problem arises, though, when adaptation is not done by way of stunting but, for example, by reducing activity. Thus, stunting is always a sign of deprivation although the absence of stunting does not mean that deprivation did not occur. Moreover, our data concentrates on moderate and severe stunting while the small-but-healthy hypothesis only refers to mild-to-moderate. The fact that adaptation to severe malnutrition is not costless is not disputed.

The reference population -as recommended by WHO (1995: p. 176)- are standard sizes of children in the United States which are assumed to be well-nourished. There exists a wealth of studies that have shown that growth of normal, healthy and adequately nourished children in other countries, independent of ethnicity, almost always approximates these reference values.[9]

Yet, in nearly every discussion about the use of stature as a measure of living standards -particularly with laymen- the question arises: "What about genetics?". This is of course an important question when data covering the whole developing world is used. However, genetic factors as an explanation for average stature of a group of people can be usually dismissed for a number of reasons. Genes are important determinants of the growth potential of an individual but when a group average is taken, these differences approximately cancel each other out and the variance between group averages can be largely attributed to environmental factors (Steckel 1995: p. 1903; Tanner 1994: p. 1). Moreover, as long as the genetic composition of the population does not change over time (for example through large scale migration), genetic factors can be ignored when trends of stature are analyzed over time (Komlos 1994a: p. 98).

Martorell *et al.* (1988) demonstrated that differences in the stature of children around the world are more a reflection of poverty than genetics. They used four pieces of evidence:
(1) the developed countries have seen a significant rise in stature since the nineteenth century. Assuming that the genetic endowments were unchanged, the rise can be attributed to a changing environment;

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[9] See, for instance: Dasgupta 1993: pp. 83-84; FAO and WHO 1992: p. 11; FAO 1996: pp. 145-146; Martorell *et al.* 1988: pp. 62-65, 68; Osmani 1987: p. 44; Payne and Lipton 1994: p. 23; Steckel 1995: p. 1910; Tanner 1978: pp. 137-139; UNICEF 1993a: p. 7). The point is summarized by the WHO: "...[G]rowth patterns of children of different ethnic groups result in a worldwide height variability of about 1 cm in 5-year-old children." (WHO 1995: p. 177). Some have even argued that "..The debate about growth standards is dead..." (Ramalingaswami *et al.* 1996: p. 11). They quoted a recent study by the Nutrition Foundation of India that has shown "...yet again that the growth curves of children in better-off Indian families follow the same pattern as those of adequately nourished children in other parts of the world..."

(2) there are large differences in stature among groups of different socio-economic status within countries. In all cases, the group with higher socio-economic status are taller. Only in Guatemala this might partly reflect genetics as the very poor have a greater share of Indian descent than the elite.[10] But it is unlikely that this genetic bias operates in every country in the same direction;
(3) a comparison of children from different ancestry living in well-to-do situations across the world shows that they all center around the 50th percentile. The only exception are Asians who are about 3.5 centimeter shorter and center around the 25th percentile. This is small compared with the effect of poverty which can reduce the average height by 12 centimeter or more. They suggested, however, that it may be due to different feeding practices of infants between eastern and western cultures (Martorell *et al.* 1988: p. 67);[11]
(4) they compare the height z-scores of three groups with different ethnicity (European (non-hispanic), black and Hispanic) at different poverty levels within the United States. In all groups, children are smaller when they are poorer. Moreover, for ages 1 to 5 and 6 to 11, the European and Hispanic groups have z-scores of nearly zero at the high-income level. For these ages, blacks were taller. At ages 12 to 17, the European and black groups become nearly identical and have z-scores of nearly zero at the high-income level. Hispanics, however, are smaller at all income levels and all ages but the difference is small at the high-income level. These pieces of evidence allowed them to conclude that "...the growth potential of children around the world is remarkably similar under conditions of adequate nutrition and health..." (Martorell *et al.*, 1988, p. 68).

4. Can the validity of the e.i.g.-puzzle be tested against contemporary evidence?

Can the validity of the 'early industrial growth puzzle' as a general phenomenon, accompanying economic modernization, be checked against evidence from the current developing countries? In other words, what is the validity of a comparison of the industrialization during the nineteenth century of the now-developed countries and development in the current developing countries? A number of issues needs to be addressed.

Firstly, the international economic environment of present-day developing countries with regard to trade, technology, finance, aid, and investment is much different from the historical experience of the now-developed countries (Lewis 1977). The presence of large export markets, the possibility of technology transfer, the access to finance and aid, and the scale of foreign direct investment have a definite effect on the development process in developing countries. Moreover, now-developed countries exploited

[10] See on this issue, e.g. Bogin, Wall, and MacVean (1992).
[11] See also: Ramalingaswami *et al.* (1996).

developing countries, an opportunity not available to the present day developing countries while they are still coping with the consequences.

Secondly, the question can be posed whether the developing countries in our sample are indeed in some early phase of industrialization. According to Maddison (1995), GDP per capita at 1990 (PPP) dollars was generally between $1000 and $2000 in the now-developed countries in the first half of the nineteenth century. That is similar to current levels of GDP per capita of most in the African and Asian countries in our sample. For example, Maddison (1995: p. 228) estimated that GDP per capita at 1990 (PPP) dollars for Western Europe in 1820 and Africa in 1971 and 1992 were the same, *viz.* $ 1290 (give and take a few dollars). This level was, however, already reached by Latin America in the early 1900s and in the 1960s by Asia. Moreover, it is important to realize that there is, also quite some variation *within* the continents.

Yet, growth of GDP per capita -if that is a proper indicator of economic modernization- has been faster in the current (non-African) developing countries in the post-World War II period, in particular in Asia, than in the now-developed countries in the nineteenth century. For example, growth of GDP per capita averaged 1.0 per cent in Western Europe for the period 1820-70 and 1.3 for 1987-1913 but 3.8 per cent for Asia (including Japan and Oceania) during the period 1950-73 and 3.2 per cent during 1973-92 (Maddison 1995: p. 60).

It seems that -as far as the sketchy data allow any conclusion- the share of the agricultural sector in the economy is also broadly comparable. Maddison (1995: p. 39) indicated that the share of the labour force in agriculture was between 35 and 70 per cent between 1820 and 1870 for the now-developed countries. That is similar to the range found in the developing world, despite the fact that some (mostly African) countries have higher shares and some (mostly Latin American) countries have lower shares (UNDP 1996).

Thirdly, the state of medical knowledge has advanced and the current developing countries can thus benefit from technology unavailable to the now-developed countries in the nineteenth century. Actually, the impact of medical science was fairly limited before the twentieth century. Already in the sixteenth century, the understanding of epidemics lead to the removal of waste and the use of quarantines and contributed to the decline and in mortality rates in Europe (Boserup 1981: p. 124). In the second half of the nineteenth century, several disease-producing organisms were identified. Yet, the contribution of medical science to the combat against infectious diseases only started to increase significantly in the twentieth century with the discovery and widespread use of several vaccines and antibiotics. Boserup (1981: p. 123) wrote, for example, "...[o]nly in one case, that of smallpox, had medical science and its application reached a stage which might help to explain the eighteenth-century decline of mortality..." Smallpox was, however, an anomaly. Inoculations against smallpox started in 1721 almost two centuries before large-scale vaccinations gained prominence (first against bacteria) and more than two centuries before viruses (such as smallpox) itself were better understood.

The breakthroughs in medical research of the twentieth century have directly benefitted the developing countries (Boserup 1981: p. 177). UNICEF (1991; 1996a) has shown, for example, that large gains have been made since the mid-1980s with regard to immunizations and oral rehydration therapy (ORT). These techniques are available to developing countries at low or no costs (in case of aid) -$ 0.10 per sachet of ORT- and are credited for reducing the incidence of several diseases and mortality rates.[12] And a lower incidence of diseases leads *ceteris paribus* to lower malnutrition rates.

Indeed, the evidence suggests that at similar levels of GDP per capita, the infant mortality rate is lower in the present developing countries than in nineteenth century Western Europe. During the entire nineteenth century, the infant mortality rate rarely fell below 150 in all European countries for which data are available, with the exception of some Scandinavian countries, Ireland, and Scotland, and the rate only fell definitely below 90 after 1900 in countries such as Norway (Mitchell 1976). In the developing countries, however, there were only a handful of countries with an infant mortality rate above 150 during the 1980s (e.g. Afghanistan, Guinea-Bissau, Mali, Mozambique, and Sierra Leone). In fact, during the first half of the 1990s there were only three with a mortality rate higher than 150 (Afghanistan, Mali, and Sierra Leone) and the average rate for all developing regions was below 100: 93 for Africa, 65 for Asia (including Japan), and 45 for Latin America and the Caribbean (United Nations, 1995).

Fourthly, the technology to transport perishable food, such as fruits and dairy products, has much improved since the nineteenth century.[13] This allows a much more equal distribution of these kinds of food across regions, improving the nutritional content of food intake.

Fifthly, do anthropometric indicators for children give different results than for adults? The height of adults, as frequently used by economic historians, is a final measure, reflecting the biological standard of living during the years they were growing which could have covered two decades or more and which could have occurred a few decades earlier. The height of young children, on the other hand, reflects more recent conditions, in our case less than five years. Body measurements of children in particular are rather sensitive to changes in the intake of protein and calories, in addition to diseases. Moreover, measurements at a young age do often not reflect catch-up growth. Yet, it is argued that complete catch-up growth in developing countries is not very common because the causes of stunting often endure.[14]

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[12] UNICEF (1996b: p. 27). It should be noted, however, that the effectiveness of ORT was discovered in Bangladesh and India (UNICEF 1996a: p. 58).

[13] This point was suggested to us by Professor John Komlos.

[14] For instance: Dasgupta 1993: pp. 84-85; FAO 1996: p. 145; Fogel 1994: p. 381; Payne and Lipton 1994: pp. 3, 22: WHO 1995: p. 268.

Sixthly, it is possible that the data reconstructed in retrospect for the now-developed countries are less reliable and accurate than the data for the developing countries. On the other hand, measurement problems for the developing countries are also large as indicated by the articles in the June 1994 issue of the *Journal of Development Economics* (cf. e.g.: Heston 1994).

Finally, the analysis here is based on a pooled sample of cross country and time series data with only observations for a few years per country. Replicas of the historical evidence for the 'early industrial growth puzzle', are rather infrequent in our sample. That is, there are in our data set six countries where GDP per capita and stunting both increased between two survey years: Honduras (1987, 1992), Laos (1984, 1994), Lesotho (1981, 1994), Myanmar (1980-81, 1983-85), Pakistan (1985-87, 1990-91), and Rwanda (1976, 1992). It is important to note that there are many more countries in the sample where GDP per capita and stunting both declined between two survey years, as will be shown in the next section.

5. The data

The data used in this paper come from UNICEF's data base. UNICEF's data, which are primarily based on nationally representative household surveys, partly come from other international organizations such as the World Health Organization (WHO),[15] the Pan American Health Organization (PAHO) and the World Bank. Except for the most recent estimates, the data were published by UNICEF (Carlson and Wardlaw 1990; UNICEF 1993a; UNICEF 1993b).

This data set contains 169 observations for the prevalence of stunting. However, 22 were excluded because they referred to a subnational population. Most of the surveys were conducted in the 1980s and 1990s but the sample also includes 24 (out of 147) observations for the 1970s.

To compare the data across time and space, the age at which the child is measured, the cut-off point, and the reference population should be the same. As discussed, WHO recommended that two standard deviations should be used as a cut-off point.[16] All countries in our sample used this cut-off point. WHO (1983; 1995) also recommended to use the reference population established by the United States National Center for Health Statistics. Comparability is harder to establish with regard to the age at which the children are measured. Most of the estimates refer to children under five years of age. If, however, certain age groups are excluded (or added), the estimates are not comparable across countries because the extent

[15] WHO initiated in 1986 a Global Database on Child Growth to compile and disseminate the results of anthropometric surveys.

[16] Cf.: section 3 of this paper; note 6 of this paper.

of stunting differs according to age. In fact, the prevalence of stunting by age shows a similar pattern across countries. Typically, stunting is lowest during the first year and then increased rapidly during the second year of a child's life. After the second year, the extent of stunting remains rather flat (Carlson and Wardlaw 1990: pp. 29-30; UNICEF 1993a: p. 14). Hence, the extent of stunting will be overestimated in any country where (some) children under the age of one are not measured (or where children older than five are also measured) and underestimated in any country where (some) children of the between ages one and five children are not measured. In our sample, stunting might be overestimated in 38 cases and underestimated in 23. However, for 22 observations the ages were not known.

UNICEF (1993b) calculated age-adjusted data to improve the comparability across time within a country but no attempt was made to adjust the data for age across countries.[17] To account for this bias, two dummy variables were added in the regression analysis, one for those countries where part of first year was not measured or children older than five were also measured and one dummy for those countries where any of the period between ages one and five was not measured. Although, these dummies cause some econometric problems which will be discussed later.

6. Data analysis

In this section we will analyze whether there is any evidence for the 'early-industrial-growth-puzzle' in contemporary developing countries, using the UNICEF data on stunting. First we will look at the first part of the e.i.g-puzzle, that is to say, on the divergence of stunting and GDP per capita. The determinants of this divergence will be investigated in the second part of this section.

6.1 The relation between stunting and GDP per capita

For a preliminary examination of the data, Figure 1 presents the percentage of children stunted and GDP per capita (converted by exchange rates and projected on a logarithmic scale).[18] If the mechanisms that were apparently at work in the several historical cases of the early-industrial-growth-puzzle, were also

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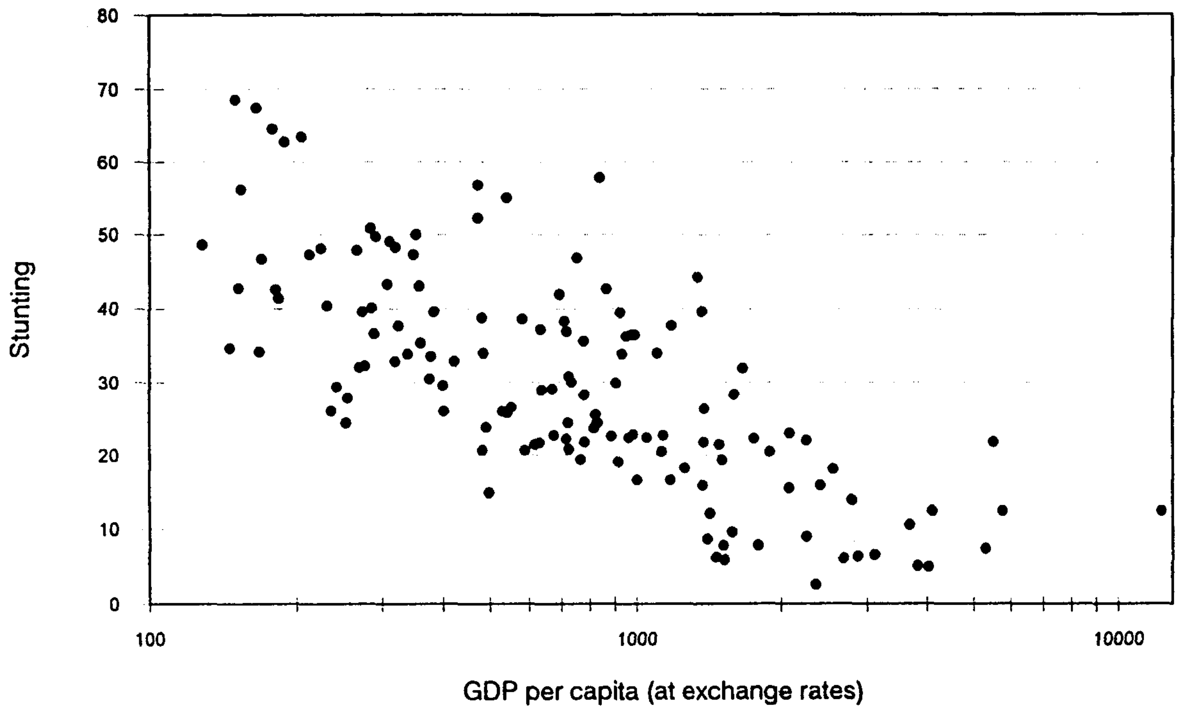
[17] The age adjustments were made in the following way. The percentage of children stunted in the survey with the shorter time span (e.g. 12-59 months) was multiplied by the ratio of the percentage of children stunted for the same shorter time span (e.g. 12-59 months) to the percentage of children stunted for the total time span (e.g. 0-59 months) in the survey with the longer time span (e.g. 0-59 months).

[18] We also ran the regressions of Table 1 with GDP per capita at PPPs but the number of observations was less (104) and results worse (lower adjusted R^2 and lower t-statistic).

influencing height patterns over time in our example, one would expect that stunting increases before it declines again when GDP per capita increases, i.e. stunting against GDP per capita would display an inverted-U shape in Figure 1. Figure 1, however, does not seem to show an inverted-U shape but rather a negative monotonic non-linear relation between stunting and GDP per capita. The figure also reveals that there are large deviations from a straight line. There is thus enough room for further analysis of the factors which can cause stunting not to be closely associated with GDP per capita.

FIGURE 1: STUNTING AND GDP PER CAPITA IN DEVELOPING COUNTRIES



A second, and more reliable test whether the mechanisms underlying the e.i.g-puzzle are also at work in contemporary developing countries, consists of running a regression with stunting as the dependent variable and GDP per capita as the independent variable. One would expect that a quadratic term will enter the regression equation with a negative sign and will be statistically significant. Table 1 presents the regression results which confirm the preliminary analysis of the figure. Regression (1) only includes GDP per capita in a linear form. In regression (2), GDP per capita is included in a quadratic form. Supposing the mechanisms of the e.i.g.-puzzle were indeed at work, we would expect a negative coefficient, but the coefficient is positive and significant.[19] Regressions (3) and (4) contain another non-linear form, *viz.* the

[19] The observations in the sample almost all fall to the left of the minimum value of the parabola and are thus scattered around the downward sloping part.

natural logarithmic transformation of GDP per capita.[20] The coefficients of the semi-log function gives the change in stunting (in percentage points) as a result of a percentage change in GDP per capita (Kennedy 1992: p. 106). The results for regressions (3) and (4) are better than for regressions (1) and (2): adjusted R^2 and F-statistic are both higher and the RESET statistic lower, yet remain insignificant.[21] T-statistics are lower in regression (4) although that is a result of the correlation between LGDP/C and LGDP/C^2.[22] Moreover, when the adjusted R^2 of regression (3) is compared with the adjusted R^2 of regression (4) it is clear that LGDP/C^2 adds very little to the explanatory power of the equation.

Another way to look at the validity of the arguments used by Komlos to explain the early-industrial-growth-puzzle for the case of contemporary developing countries, is by including dummy variables for the different time periods. There are 46 countries in our sample with more than one observation. Dummies DT1, DT2, DT3, and DT4 have been assigned to the first, second, third, and fourth survey, respectively.[23] If the Komlos-thesis has validity and development takes off between the first and last survey, then one would expect that the coefficient for DT1 is smaller than for DT2 and/or DT3. A coefficient for DT1 smaller than for DT2 would indicate that in the countries with more than one survey, during the period of the first survey stunting was lower than during the second survey, independent of GDP per capita. It could also be that the coefficient for DT2 is smaller than for DT3 and that the coefficient for DT3 is smaller than for DT4 but that depends on whether the "early stages of rapid economic growth" (Komlos 1994b: p. 213) have been completed. In the case that the early stage has been completed, the coefficient of DT4 could be smaller than the other coefficients and the coefficients of DT1, DT2, DT3, and DT4 could create an inverted-U shape.

Yet, this is admittedly not a very sophisticated test as all surveys could be conducted in the period before development takes off or *vice versa*, i.e. in the period after development takes off. What is tested here is that if there is more than one observation per country, stunting is less prevalent in the earlier period(s) despite the fact that GDP per capita is lower.

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[20] In addition a log-log form, where both stunting and GDP per capita was transformed, was estimated. The results where practically the same as in equation (3) with an adjusted R^2, F-statistic, and t-statistic marginally lower.

[21] Ramsey's RESET test is a general test for specification error. A insignificant value can indicate omitted variables, incorrect functional form, and/or correlation between the independent variables and the error term.

[22] Note that LGDP/C and LGPD/C^2 are not perfectly correlated because LGDP/C^2 = $(\ln(GDP/C))^2$ =/= $\ln((GDP/C)^2)$. A typical effect of multicollinearity is lower t-statistics. Similar to regression (2), the observations are scattered around the downward sloping part of the function.

[23] Note that we have not assigned a dummy to countries with only one observation for one survey. Thus, all dummies can be included in the regressions. In normal cases with dummy variables this would be impossible because the sum of the dummy variables would be equal to the intercept variable, creating perfect multicollinearity.

Table 1 *Regressions with Stunting as Dependent Variable*

Form	linear	linear	semi-log	semi-log	linear	semi-log
# regr.	(1)	(2)	(3)	(4)	(5)	(6)
Constant	36.10** (26.32)	42.18** (28.30)	107.25** (17.29)	158.27** (4.47)	40.99** (16.44)	107.91** (15.19)
GDP/C	-0.005** (7.18)	-0.014** (9.87)			-0.01** (9.53)	
LGDP/C			-11.75** (12.57)	-27.22* (2.56)		-11.82** (12.04)
$(GDP/C)^2$		0.000001** (6.77)			0.000001** (6.67)	
$LGDP/C^2$				1.15 (1.46)		
DT1					2.92 (1.12)	1.05 (0.44)
DT2					0.21 (0.08)	-1.51 (0.63)
DT3					0.40 (0.11)	-1.34 (0.40)
DT4					1.63 (0.24)	3.24 (0.53)
adj. R^2	0.271**	0.452**	0.536**	0.540**	0.443**	0.529**
F-stat.	51.50	57.17	158.11	80.79	19.06	31.53
RESET(2)	38.21	12.19	1.59	1.44	10.80	1.34
# obs.	137	137	137	137	137	137

Note: For legends of variable abbreviations and definitions: see Appendix 1.
Absolute value of t-statistics between parentheses.
All regressions estimated with OLS.
* significant at the 5 per cent level
** significant at the 1 per cent level

The results are presented in regressions (5) and (6) in Table 1. The results are not encouraging. All dummies are insignificant and the equations lose explanatory power compared with regressions (2) and (3), respectively. Moreover, the pattern of the dummies follow a U shape and not an inverted-U shape, nor do they form an upward sloping curve.

6.2 The determinants of stunting

Regression analysis can also be used to investigate the second part of Komlos' explanatory scheme for the early-industrial growth-puzzle *viz.* the determinants of the deviations between stunting and GDP per capita. A number of possible variables to explain these deviations have emerged from the literature.[24] A summary of the sign expectations for the regression analysis is presented in Table 2.

Firstly, a higher incidence of several diseases reduces net nutrition. When a person is infected, energy requirements increase and hence there is less energy available for growth if food intake (gross nutrition) remains the same.[25] Moreover, the body is not able to absorb adequately the food consumed in cases of severe infection.[26] Two variables are used as direct proxies for the disease incidence, *viz.* the infant mortality rate (IMR) and life expectancy at birth (LE). The infant mortality rate was also used by Floud (1994) as a proxy for the disease environment. Yet, he argued that is an imperfect measure because "...diseases of childhood and adolescence also affect growth..." (Floud 1994: p. 23). That is true but the infant mortality rate is highly correlated with the under-5 mortality rate and with life expectancy as well (see Table 3).

Secondly, the poorest segments of the population are likely to spend more on food than the richest segments when income increases. In other words, the marginal income elasticity of food is high (perhaps close to one) for the poor.[27] Moreover, GDP per capita is an average which is heavily influenced by outliers (i.e. a skewed income distribution), while stunting has an inherent maximum (100 per cent) and minimum (0 per cent). Hence, it is likely that a more equal distribution of income (larger EQUALITY) will lead to lower stunting, even if GDP per capita stays the same. Steckel (1995: p. 1928) and Komlos (1994b: p. xii) argued that the income distribution worsened during the early phases of industrialization and contributed to the decline in height in the nineteenth century.

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[24] See also, for example: Steckel 1995: pp. 1926-1931; Komlos 1994a; Komlos 1994b.

[25] See Fogel (1994: p. 371) and Steckel (1995: p. 1910) for the distinction between gross nutrition (food intake) and net nutrition (balance between food intake and the claims from e.g. diseases and activity on it).

[26] These increased requirements are on top of the likelihood of smaller intake as a result of a reduced appetite when a person is sick (Dasgupta 1993: pp. 404-409; FAO 1996: pp. 3-5, 44; Osmani 1987: pp. 69-70; Payne and Lipton 1994: p. 34; WHO 1995: p. 178).

[27] In developing countries, the evidence suggests that the income or expenditures elasticities of calories are not as large as often assumed: between 0.10 and 0.60. Perhaps, even very poor households purchase only additional taste and non-calorie nutrients when income rises (Strauss and Thomas 1995). But there is increasing evidence that nutrients other than calories and protein (e.g. vitamin A, zinc, and iron) are also important for reaching normal stature (WHO 1995: pp. 177-178).

Table 2 *Sign or Value Expectation of Independent Variables*

Independent variable	Description	Sign or value expectation	Explanation
GDP/C	GDP per capita	MINUS	'e.i.g.-puzzle' evidence
IMR	infant mortality rate	PLUS	disease incidence
LE	life expectancy	MINUS	disease incidence
URBAN	urbanization rate	UNDECIDED	incidence infectious diseases, food prices VERSUS access to health services, sanitation, safe water
EQUALITY	income share of poorest 40 % of households	MINUS	sensitivity to income of poor
AGR/GDP	share of agriculture in GDP	MINUS	food production
CALORY	per capita daily supplies of kilocalories	MINUS	food availability
PROTEIN	per capita daily supplies of protein	MINUS	food quality
AID	per capita food aid	MINUS	food availability
DSAsia	dummy: South Asia = 1	PLUS	genetic, cultural, and environmental factors
DEAsia	dummy: East Asia = 1	PLUS	genetic, cultural, and environmental factors
DLatin	dummy: Latin America and the Carribean = 1	ZERO	genetic, cultural, and environmental factors
DT1	dummy: period of the first survey = 1	UNDECIDED	Value DT1 < DT2?
DT2	dummy: period of the second survey = 1	UNDECIDED	Value DT2 < DT3?
DT3	dummy: period of third survey = 1	UNDECIDED	Value DT3 < DT4?

Table 2 (continued) *Sign or Value Expectation of Independent Variables*

Independent variable	Description	Sign or value expectation	Explanation
DT4	dummy: period of fourth survey = 1	UNDECIDED	Value DT3 < DT4?
D+bias	dummy = 0 for countries where stunting is not measured for part of first year, or where children older than 5 years are also measured	PLUS	Upward measurement bias, related to age
D-bias	dummy = 1 for countries where stunting is not measured for part of the ages between 1 and 5	MINUS	Downward measurement bias, related to age

Thirdly, several studies found that in relatively poor remote areas in a diverse number of now-developed countries in the nineteenth century, people were often relatively tall.[28] Several factors might explain this phenomenon. The remoteness can protect the population from disease encounters and the urbanization rate can thus also be a proxy for the likelihood of being infected. Remoteness can also be related to the access to food as rural households produce often part of the food they consume themselves. Urbanization increases the demand for food and if this is not accompanied by an increase in agricultural productivity, food prices will rise. Moreover, food prices in urban areas are higher than in rural areas where food is produced because retail, wholesale, and transportation costs are larger. The urbanization rate is thus likely to have a positive effect on stunting.

However, the evidence that people in rural areas were taller than urban residents in the nineteenth century is contrasted by the reverse pattern today in developed and developing countries (Floud 1994: p. 24; Komlos 1994a: p. 104; Tanner 1978: pp. 144-146). This might be explained by the higher incidence of health and sanitation services in urban areas. Public health facilities in particular, only became widespread in the twentieth century. Thus, in nearly every developing country the percentages of the population without access to health services, sanitation, and safe water are (much) higher in rural areas (UNDP 1996: Table 8).

[28] See, for instance: Floud 1994: p. 24; Komlos 1994a: pp. 100, 104; Komlos 1994b: p. xiii; Shay 1994: pp. 190-195; Steckel 1994: pp. 160, 164, 166; Tassenaar 1995.

This pattern is translated into the anthropometric evidence from the developing countries. UNICEF (1993a: p. 13) showed that in each of the 41 countries with data on urban-rural disparities, the prevalence of underweight was higher in rural areas than in urban areas. UNICEF (1993b) also provided data on stunting and confirmed the pattern. There are 54 different surveys which separated urban and rural areas and for 52 of them, stunting is more prevalent in rural areas than in urban areas. Only in one survey the reverse was the case, while in another the prevalence was the same.

Fourthly, Komlos (1994a: p. 104; 1994b: p. 218) suggested that the share of agriculture in GDP is an important determinant of height because of its effect on food entitlements. Thus, at very low incomes, the economy is primarily based on agriculture, the level of market integration is rather low and people living in rural areas have relatively easy access to food and could be relatively tall. In addition, three other indicators of food availability have been included in the regression analysis, *viz.* per capita daily supplies of kilocalories (CALORY) and protein (PROTEIN), and food aid per capita (AID). These are of course all expected to have a negative effect on stunting.

Finally, a number of dummy variables were added to the regression equation. Dummies for the measurement biases and for the different regions were used. As discussed above, the conjecture is that only the dummy for Asia should be significant. However, this should be interpreted with care as it might reflect genetic, cultural and environmental factors.[29] We have actually included two dummies for Asia, one for South Asia and for East Asia as the prevalence of stunting and wasting has been particularly high in South Asia.

The dummies for the measurement bias create an econometric problem. Regressions with a dependent variable with a measurement error (such as the one in stunting) are less efficient but still yields unbiased and consistent estimates because the measurement error gets added to the error term of the equation. When dummies are included to account for the measurement error in stunting, however, the dummies will be correlated with the error term of the regression, yielding biased and inconsistent estimates.[30] For this reason, we will report most regression equations without D+bias and D-bias. It might, however, be noted that the dummies do take the expected sign (see Table 2) when they are included and that they are almost always insignificant with t-statistics less than one (see for example regression (2) in Table 4). D+bias is sometimes significant at the 10 per cent level when not many other independent variables are included. Typical values of the coefficient are 3 for D+bias and -2 for D-bias. If one, for the sake of the argument, assumes that these values are unbiased, they would indicate that the extent of over or underestimation of

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29 See for instance: Steckel 1995: p. 1915; and Ramalingaswami *et al.* 1996.

30 Cf.: Pindyck and Rubinfeld 1981: pp. 175-177.

stunting in countries where some children under the age of five are not measured amounts only to a few percentage points.

6.3 The introduction of a PDL-lag structure into the regressions

Following Brinkman, Drukker, and Slot (1988), a polynomial distributed lag (PDL) of GDP per capita was included in the regression equations. In the case with cross-section data, the application was a bit more complicated. A polynomial distributed lag is estimated in the following way.[31] We first assume a third-degree polynomial and a six-period lag with no restrictions. Six lags are chosen because children were generally measured during their first 5 years of age and the material living conditions of the mother during the pregnancy have lasting effects (WHO, 1995, pp. 44-47; *New York Times*, 1 October 1996).

The PDL equation is:

$$Y_{jt} = \alpha + \beta\,(w_0\, X_{jt} + w_1\, X_{jt-1} + \ldots + w_5\, X_{jt-5}) + \gamma\, Z_{jt} + \epsilon_{jt} \qquad (1.1)$$

with the assumption that $w_i = c_0 + c_1\, i + c_2\, i^2 + c_3\, i^3 \qquad i = 0,1,2,3,4,5$ (1.2)

Y_{jt} is the dependent variable (stunting in our case), X_{jt-n} is the independent variable for which the PDL is estimated (GDP per capita), and Z_{jt} are other independent variables (such as the infant mortality rate). In the normal case, the equation would be estimated for time series and the variables would only have a *t* subscript. Here, however, there is a subscript *j* referring to the cross section of countries.

Substitution (1.2) into (1.1) and rewriting gives:

$$Y_{jt} = \alpha + \beta\, c_0\, X_{jt} + \beta\,(c_0 + c_1 + c_2 + c_3)\, X_{jt-1} + \beta\,(c_0 + 2c_1 + 4c_2 + 8c_3)\, X_{jt-2} +$$

$$\beta\,(c_0 + 3c_1 + 9c_2 + 27c_3)\, X_{jt-3} + \beta\,(c_0 + 4c_1 + 16c_2 + 64c_3)\, X_{jt-4} +$$

$$\beta\,(c_0 + 5c_1 + 25c_2 + 125c_3)\, X_{jt-5} + \gamma\, Z_{jt} + \epsilon_{jt} \qquad (1.3)$$

[31] Pindyck and Rubinfeld 1981: pp. 238-239.

Combining terms gives the equation as it is estimated:

$$Y_{jt} = \alpha + \beta\, c_0\, (X_{jt} + X_{jt-1} + X_{jt-2} + X_{jt-3} + X_{jt-4} + X_{jt-5}) +$$

$$\beta\, c_1\, (X_{jt-1} + 2X_{jt-2} + 3X_{jt-3} + 4X_{jt-4} + 5X_{jt-5}) +$$

$$\beta\, c_2\, (X_{jt-1} + 4X_{jt-2} + 9X_{jt-3} + 16X_{jt-4} + 25X_{jt-5}) +$$

$$\beta\, c_3\, (X_{jt-1} + 8X_{jt-2} + 27X_{jt-3} + 64X_{jt-4} + 125X_{jt-5}) + \gamma\, Z_{jt} + \epsilon_{jt} \qquad (1.4)$$

Instead of six lagged variables (X_{jt} to X_{jt-5}) in equation (1.3), there are now only four transformations of lagged values of GDP per capita in equation (1.4), which we will call GDPPDL1 to GDPPDL4. Hence, we have gained two degrees of freedom. Moreover, multicollinearity between the lagged variables is less likely to be a problem because the correlation between for example X_{jt-1} and X_{jt-2} is likely to be higher than between, for example, GDPPDL1 and GDPPDL2.

In the case of a cross-sectional PDL, we can not use the standard routine in statistical packages and have to construct the independent variables GDPPDL1 to GDPPDL4 to avoid that Y_{jt} would be explained by X_{kt}, X_{kt-1}, etc. GDPPDL1 to GDPPDL4 can be calculated for each country (data availability permitting). Thus, in the original time-series model Y_t would be explained by a transformation of X_t, X_{t-1}, etc. and Y_{t-1} would be explained by a transformation of X_{t-1}, X_{t-2}, etc. Here, in the case of say *j* = Burkina Faso, Y_{jt} is explained by a transformation of X_{jt}, X_{jt-1}, etc. and Y_{jt-1} is explained by a transformation of X_{jt-1}, X_{jt-2}, etc.. In addition, in the case of say *k* = Burundi, Y_{kt} is explained by a transformation of X_{kt}, X_{kt-1}, etc. and Y_{kt-1} is explained by a transformation of X_{kt-1}, X_{kt-2}, etc.

After $\beta\, c_0$ to $\beta\, c_3$ are estimated as in equation (1.4), $\beta\, w_0$ to $\beta\, w_5$ can be calculated by using equation (1.2). In addition, the t-statistics for $\beta\, w_0$ to $\beta\, w_5$ can be calculated by using the standard errors of the equation (1.4).[32] As Pindyck and Rubinfeld (1981: p. 239) prescribed, statistical tests need to be conducted on equation (1.3) not on the estimated equation (1.4).

Instead of imposing no restrictions on the polynomial equation (1.2), a head restriction can be introduced, because one could argue that GDP per capita at age 6 can not influence stunting at age 5

[32] If var(β **c**) = σ^2 $(\mathbf{X'X})^{-1}$, then var(β **w**) = **k** σ^2 $(\mathbf{X'X})^{-1}$ **k'**, where **k** is the matrix of transformation coefficients (e.g. k_3 = [1 3 9 27]; see equation (1.4)); where **β c** and **β w** are vectors; and where **X** is the matrix of independent variables (Johnston 1981: p. 295).

(Brinkman, Drukker, and Slot 1988). Hence, equation (1.2) is rewritten as follows. A head restriction means setting $w_{-1} = 0$. Substituting this into equation (1.2) gives $c_0 = c_1 - c_2 + c_3$ which can be substituted back into equation (1.2), yielding:

$$w_i = c_1 (1 + i) + c_2 (i^2 - 1) + c_3 (1 + i^3) \quad i = 0,1,2,3,4,5 \tag{1.5}$$

For this polynomial w = 0 when i = -1. Substituting equation (1.5) into equation (1.1) will yield similar equations as (1.3) and (1.4). For space considerations we will not reproduce the complete results but only the transformation vectors: [1 2 3 4 5 6], [-1 0 3 8 15 24], and [1 2 9 28 65 126]. The three transformations of lagged values of GDP per capita will be called GDPPDL2H to GDPPDL4H.

6.4 A simultaneous equation

One could argue that the equation should be estimated with Two-Stage Least Squares (TSLS) because some "independent" variables, such as GDP per capita, are also dependent on healthy individuals, proxied by stunting.[33] Moreover, there is evidence that stunting leads to a higher mortality risk (Fogel 1994: p. 374; WHO 1995: pp. 178-179). The use of Two-Stage Least Squares requires exogenous determinants of GDP per capita as instruments. We have followed Mankiw, Romer, and Weil (1992) who introduced a Cobb-Douglas production function which included human capital. Thus,

$$Q = K^{\alpha} H^{\beta} (A\ L)^{1 - \alpha - \beta}$$

can be rewritten as

$$\ln q = \alpha \ln k + \beta \ln H + (1 - \alpha - \beta) \ln A - \beta \ln L$$

where

q = Q / L = GDP per capita;

k = K / L = capital stock per capita;

H = human capital stock;[34]

A = level of technology; and

L = labour.

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[33] See e.g.: Fogel 1994: pp. 372, 373, 386; Strauss and Thomas 1995: p. 1908-1917.

[34] We have tried several different measures from Barro and Lee (1993) but the average years of secondary schooling of total population performed best.

Thus, we have used ln H, ln k, and ln L as instruments for ln GDP/C, in addition to the regional and survey dummies, AGR/GDP, and life expectancy (as an instrument for the infant mortality rate). The other variables, such as URBAN, CALORY, and PROTEIN, are considered exogenous and are therefore also included in the instrument list if included in the regression (see regression (5) in Table 4).

6.5 Regression results

Before we discuss the regression results which are presented in Table 4, a number of remarks need to be made about the specification. Firstly, it turns out that -in contrast to the results in Table 1- GDP per capita performs better than its logarithmic transformation: LGDP/C becomes insignificant in several cases and the adjusted R^2 declines. This, however, can be explained by multicollinearity between GDP/C and other independent variables because multicollinearity increases the variance of the estimates. Table 3 shows that the simple correlation coefficients between LGDP/C and other independent variables (such as the infant mortality rate and the urbanization rate) are higher than between GDP/C and the other independent variables. The transformations for the polynomial distributed lag (GDPPDL1 to GDPPDL4) perform also better than the logarithmic transformations of GDPPDL (LGDPPDL1 to LGDPPDL4[35]), with generally lower t-statistics and adjusted R^2. Similar to GDP/C, multicollinearity between LGDPPDL and the other independent variables is larger than between GDPPDL and the other independent variables. However, the equations estimated with two-stage least squares require the logarithmic transformation because of the shape of the Cobb-Douglas function. Thus, regressions (1) to (4) in Table 4 are with GDPPDL and regressions (5) and (6) with LGDPPDL.

We have to admit that the multicollinearity between the GDPPDL variables is more severe than expected. The simple correlation coefficient between them are all larger than 0.99. (GDPPDL3H and GDPPDL4H are, therefore, excluded in Table 3.) This makes the estimation of their coefficients less precise. A change in the sample or in the set of independent variables can change the sign, the value, and the standard errors. For a priori reasons we would have preferred the PDL form but the multicollinearity problems makes that preference less secure. The high multicollinearity is partly caused by the fact that we needed only six lags because the more lags, the higher are the values in the transformation vectors and the less likely are the variables correlated.

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[35] Actually, LGDPPDL is the PDL transformation of the lagged ln(GDP/C).

Table 3 *Correlation Matrix*

	STNT	GDPC	LGDPC	PDL2H	IMR	LE	URB	EQ.	AGRGDP	AID	CAL	PROT
STNT	1											
GDPC	-0.62	1										
LGDPC	-0.68	0.86	1									
PDL2H	-0.64	0.98	0.87	1								
IMR	0.54	-0.55	-0.70	-0.56	1							
LE	-0.53	0.59	0.73	0.61	-0.91	1						
URB	-0.51	0.48	0.70	0.53	-0.50	0.56	1					
EQUAL		0.25	-0.12	-0.26	-0.09	0.22	-0.15	-0.23	1			
AGRGDP	0.57	-0.64	-0.79	-0.66	0.59	-0.65	-0.69	0.27	1			
AID	-0.16	0.02	0.13	0.10	-0.20	0.17	0.17	0.06	-0.31	1		
CAL	-0.53	0.46	0.52	0.46	-0.36	0.42	0.38	0.03	-0.47	0.25	1	
PROT	-0.41	0.43	0.47	0.44	-0.30	0.28	0.32	0.00	-0.47	0.31	0.88	1

Secondly, two variables served as proxies for disease incidence, the infant mortality rate (IMR) and life expectancy (LE). However, LE was dropped from the equations because IMR performed better than LE -with higher adjusted R^2 and higher t-statistics- and IMR and LE are highly correlated with a simple correlation coefficient of -0.91 (see Table 3).

Thirdly, all equations are estimated with the heteroskedasticity-consistent covariance matrix (White method). The difference between ordinary least squares and the White method is not very large, although in some regressions variables on the edge of being insignificant, become insignificant or *vice versa*.

In general, the regression results (Table 4) are satisfactory. About 67 per cent of the variance in stunting is explained by the independent variables. This is about 22 percentage points higher than the regressions of Table 1 that were run on the same sample of 73 observations.[36] The F-statistics indicate that all independent variables combined are significant at the 1 per cent level. The Ramsey's RESET test statistic, however, is in some cases insignificant at the 10 per cent level.[37] This indicates that the equations might be misspecified. In fact, the specification error might be the simultaneity bias of the OLS method because the value of RESET test statistic declines for the equations estimated with TSLS. The RESET (2)

[36] It is not possible to directly compare the adjusted R^2 of Tables 1 and 4 because the sample is different and therefore the dependent variable is different.

[37] Note that the RESET statistic for regression (3) is significant at the 20 per cent level.

statistic is significant at the 5 per cent level for regression (5) while the RESET (4) statistic is even significant at the 1 per cent level for regression (6).[38]

Regression (1) in Table 4 includes GDP per capita without a polynomial distributed lag, similar to regression (1) in Table 1. In the other equations, a polynomial distributed lag is included and the results in Table 4 are reported in the same way as the equation is estimated (equation 1.4). The calculated distributed lags $\beta\ w_i$ are presented in Table 5. It is interesting that the sum of the lags (about -0.005) for equations (2) to (4) is similar to the value of the estimated coefficient of GDP/C in regression (1) in Table 4 and, as a matter of fact, to the value in regression (1) in Table 1. Yet, the shape of the distributed lag function is less stable. Regressions (2) and (3) both show an inverted-U shape but regression (4) displays a U shape with four out of five values negative. Regressions (5) and (6) also display a U shape but with a rather short right-hand arm. As a matter of fact, the coefficients $\beta\ w_i$ of all equations we estimated with TSLS follow this pattern, i.e. a U shape with a short right-hand arm.

Multicollinearity might also be the cause of the positive sum of the distributed lag $\beta\ w_i$ coefficients in regression (5). The values of the three estimated coefficients $\beta\ c_i$ are not very robust because of multicollinearity. A small change in the sample or in the list of regressors, resulting in a small change in the relative values of these three coefficient, can shift the U shape up a bit and make the sum larger than zero. Regression (6), for example, estimated with CALORY changes the estimated $\beta\ c_i$ to 5.51, -11.99, and 2.05 but yields a positive sum of distributed lag $\beta\ w_i$ coefficients.

Table 5 also compares the pattern of distributed lags with the prevalence of stunting for different ages, according to Carlson and Wardlaw (1990). The $\beta\ w_i$ coefficients of the TSLS regressions (5) and (6) are particularly compatible with the prevalence of stunting for different ages. Carlson and Wardlaw (1990) and UNICEF (1993a) showed that the great majority of children become malnourished in the period from birth to age two.[39] Indeed, $\beta\ w_3$ and $\beta\ w_4$ have the largest negative value in regressions (5) and (6). The $\beta\ w_i$ coefficients of the other (OLS) regressions match the prevalence of stunting less well, although one could defend the relative large negative and significant effect of $\beta\ w_5$ because of the evidence pointing to the importance of birth weight.

The infant mortality rate (IMR) enters positively and significantly into the regressions and is actually one of the most robust estimates. It is interesting that the value of the coefficient is much larger when the simultaneity bias is eliminated in the regressions (5) and (6). Thus, if one eliminates the dampening effect of high child mortality rates on stunting, the results are completely in accordance with what can be expected from a theoretical point of view.

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[38] For the equations estimated with OLS the RESET (2) give the highest level of significance but for the TSLS equations, RESET (3) and (when available) RESET (4) gave even higher levels of significance.

[39] See also, in this respect: Ramalingaswami *et al.* 1996: pp. 16-17.

Table 4 *Regressions with a PDL-structure*
(Stunting as Dependent Variable)

Form	linear	linear	linear	linear	semi-log	semi-log
Method	OLS	OLS	OLS	OLS	TSLS	TSLS
# REGR.	(1)	(2)	(3)	(4)	(5)	(6)
GDP/C	-0.004** (3.03)					
GDPPDL2H		0.0003 (0.28)	0.0003 (0.30)	-0.001** (2.43)		
GDPPDL3H		0.005* (1.68)	0.005 (1.60)	-0.0005 (0.22)		
GDPPDL4H		-0.001* (1.92)	-0.001* (1.86)	0.0002 (0.45)		
LnGDPPDL2H					9.135 (0.38)	5.442 (1.23)
LnGDPPDL3H					-16.789 (0.54)	-12.011 (1.390)
LnGDPPDL4H					2.740 (0.61)	2.048 (1.37)
IMR	0.124*** (3.32)	0.106*** (2.93)	0.106*** (2.94)	0.121*** (3.60)	0.194** (2.66)	0.210*** (3.09)
URBAN	0.028 (0.30)	0.040 (0.39)	0.051 (0.51)	-0.095 (1.33)	-0.058 (0.28)	
EQUALITY	-0.295 (0.92)	-0.276 (0.81)	-0.289 (0.89)			
CALORY	-0.024*** (4.10)	-0.025*** (4.01)	-0.026*** (4.42)	-0.014*** (2.99)	-0.017 (0.35)	
PROTEIN	0.660*** (3.08)	0.652*** (2.99)	0.649*** (3.05)	0.361** (2.26)	0.138 (0.23)	
AGR/GDP	0.167 (1.09)	0.209 (1.37)	0.202 (1.38)			
AID	0.015 (0.34)	0.031 (0.56)	0.027 (0.50)			
DSAsia	27.43*** (5.96)	25.82*** (5.57)	26.965*** (5.89)	23.734*** (9.70)	24.682*** (3.04)	24.237*** (4.79)
DEAsia	10.832** (2.24)	10.305** (2.05)	10.021** (2.09)	8.125** (2.47)	13.933*** (3.04)	13.109** (2.25)

(Table 4 is continued on the next page)

Table 4 (continued): *Regressions with a PDL-Structure (Stunting as Dependent Variable)*

Form	linear	linear	linear	linear	semi-log	semi-log
Method	OLS	OLS	OLS	OLS	TSLS	TSLS
# REGR.	(1)	(2)	(3)	(4)	(5)	(6)
Dlatin	3.341 (0.90)	4.065 (0.98)	3.565 (0.90)	3.787 (1.34)	4.843 (0.23)	4.309 (0.83)
DT1	-8.056** (2.13)	-8.431** (2.12)	-8.297** (2.16)	-2.744 (1.03)	-4.616 (0.19)	
DT2	-6.086 (1.55)	-5.848 (1.43)	-5.728 (1.46)	-2.682 (1.10)	-2.422 (0.27)	
DT3	-2.907 (0.62)	-2.892 (0.62)	-3.019 (0.63)			
DT4	-2.719 (0.72)	-1.230 (0.33)	-1.602 (0.42)			
D+bias		2.010 (0.82)				
D-bias		-1.288 (0.32)				
adj. R^2	0.662***	0.672***	0.680***	0.677***	0.430***	0.549***
F-stat.	10.41	8.75	10.01	20.03	5.69	12.00
RESET(2)	0.37	0.07*	0.20	0.87	0.06**	0.16
# obs.	73	73	73	110	55	56

Note: For legends of variable abbreviations and definitions: see Appendix 1.
Constants of regressions not shown.
Absolute values of t-statistics between parentheses.
* significant at the 10 per cent level.
** significant at the 5 per cent level.
*** significant at the 1 per cent level.

Table 5 *Prevalence of Stunting and the Values of the Distributed Lags of the PDL-Regressions*

Age	prevalence stunting	coeff.	eq. (2)	eq. (3)	eq. (4)	eq.(5)	eq.(6)
4	35.3	βw_0	-0.0060 (1.38)	-0.0053 (1.28)	-0.0005 (0.12)	28.66 (0.48)	19.50 1.38)
3	34.5	βw_1	-0.0017 (0.62)	-0.0015 (0.53)	-0.0020 (1.16)	23.75 (0.42)	14.98 (1.31)
2	33.5	βw_2	0.0059** (2.49)	0.0054** (2.49)	-0.0033** (2.08)	1.70 (0.09)	-1.28 (0.29)
1	35.3	βw_3	0.0102* (1.90)	0.0092* (1.86)	-0.0032 (0.84)	-21.04 (0.71)	-16.99 (1.39)
0	18.0	βw_4	0.0044 (1.02)	0.0038 (0.93)	-0.0008 (0.26)	-28.03 (0.47)	-19.86 (1.46)
-1	-	βw_5	-0.0183*** (2.99)	-0.0168*** (3.01)	0.0052 (1.39)	-2.83 (0.06)	2.38 (0.20)
Sum			-0.0055	-0.0052	-0.0046	2.208	-1.264
Average			-0.0009	-0.0009	-0.0008	0.368	-0.211

Note: The numbers of the regressions refer to the equations in Table 4.
Source for prevalence of stunting: Carlson and Wardlaw (1990: p. 28)
Absolute values of t-statistics between parentheses.
* significant at the 10 per cent level.
** significant at the 5 per cent level.
*** significant at the 1 per cent level.

The urbanization rate (URBAN) is not significant in any of the equations and has in some of them a sign contrary to expectations. However, URBAN is -not surprisingly- correlated with other independent variables, such as GDP per capita and the share of agriculture in GDP (AGR/GDP) (see Table 3). This is likely to be the cause of the change in the sign of URBAN in regression (5).[40] As noted before, multicollinearity typically increases the standard errors and can also change the sign when a different sample is used or other variables are included.

Income inequality (EQUALITY) has the expected sign but is not significant. However, given the poor quality of the data (see Appendix 1) we would not attach too much value to this result.

[40] Multicollinearity might also explain the fact that a similar variable had a positive sign for adolescents and a negative sign for adults in Steckel (1995: p. 1914) while both were negative in Steckel (1983).

The supply of calory and protein are both significant in all regressions except in regressions (5) and (6) which are estimated with TSLS. Only CALORY has the expected negative sign but this is likely to be caused by multicollinearity because if PROTEIN is included but CALORY is not, the sign of PROTEIN changes and remains significant. This can also be confirmed in Table 3 which shows that CALORY and PROTEIN are both negatively associated with stunting and that CALORY and PROTEIN are highly correlated (simple correlation coefficient 0.88).

The variable measuring the size of the agricultural sector (AGR/GDP) is insignificant in all regressions. The fact that the sign nor the value of this variable changes much when other variables are included or when the sample changes, indicates that multicollinearity is not a likely problem despite some collinearity with other independent variables such as the urbanization rate.

The amount of food aid per capita (AID) is not significant in any of the equations either. This is perhaps not surprising as the availability of food is also measured by CALORY and PROTEIN although the methodology and accuracy of the different measures varies.

Because EQUALITY, AID and AGR/GDP are insignificant at the 10 per cent level they are dropped from the equation in regressions (4), (5), and (6). In addition, in the equations estimated with TSLS, CALORY and PROTEIN also became insignificant and were also dropped as was URBAN.

One of the interesting results of the regression analysis is the fact that the dummies for Asia are always positive and significant at the 1 per cent level. The value of the coefficient for South Asia is about 25, which means that in South Asia the percentage of children stunted is about 25 percentage points higher in South Asia than in Africa (the continent for which DSAsia, DEAsia, and DLatin are zero) even when controlled for other factors, such as lower mortality rates. The dummy for East Asia (DEAsia) is also significant but has a lower value, about 10. As expected, the dummy for Latin America (DLatin) is not significant but has a positive value of about 4.

There has been some discussion in the literature why the incidence of malnutrition among children in South Asia is so much higher than in Africa or anywhere else for that matter. No clear consensus has, however, emerged (Ramalingaswami *et al.* 1996). A number of factors -among them poverty, inequality, food production and government intervention- either would lead to the opposite expectation or to about equal incidence. Some of the difference can be attributed to the higher mortality rates among children in Africa: Mortality can partly be explained by malnutrition but after a child dies it can not be counted as malnourished anymore.[41] Lower birth weights, different feeding patterns, higher incidence of diseases and

[41] The fact that the infant mortality rate has a positive coefficient in the regressions (see Table 4), suggests that the disease environment has a more important effect than the effect of excluding deceased children from being counted as malnourished.

lower levels of hygiene in South Asia are other likely factors. Better access to health care in Asia might prevent these factors to be translated into higher death rates.

The regression results cast some light on this discussion. Factors, such as the urbanization rate, income inequality, and food availability all contribute to the explanation of the variance of stunting across countries. But these factors add very little or nothing to the difference between Africa and South Asia as about 25 percentage points remain unexplained which equal to the difference found by Martorell *et al.* (1988) (see section 3 of this paper) and is similar to the 23.2 percentage points difference between sub-Saharan Africa and South Asia reported by (UNICEF 1993a: p. 17) or the 22 percentage points reported by (FAO 1996: p. 69).[42] Hence, this gives some credence to the conjectures of Ramalingaswami *et al.* (1996) that cultural factors, affecting feeding practices in particular, are important. Cultural factors are, however, hard to measure and are often -as we have done in this case- assumed to be captured by dummies.[43]

Surprisingly, the dummies for the different surveys (DT1 to DT4) have a rather stable pattern. A pattern, however, we expected in the regressions with only GDP per capita as the other independent variable as reported in Table 1 but not in these regressions which include other independent variables supposedly capturing the effect Komlos predicted. The dummies in Table 4 are monotonicly increasing in value, ranging from about -8 for DT1, -6 for DT2, -3 for DT3, to -2 for DT4. This pattern could be in accordance with the mechanisms underlying Komlos' explanation of the early-industrial-growth-puzzle, as argued in section 6.1.

7. Conclusions

This paper has not definitely settled the question whether the mechanisms, suggested by Komlos and Steckel to explain the early-industrial-growth puzzle, have also been at work in the same way in the recent experience of the developing countries. Rather we have tried to provide the opening pass. There might be

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[42] The data in our sample reveal about a 22 percentage point difference between sub-Saharan Africa and South Asia. This is based on averages (of all data, independent of year) which are weighted by the total population (rather than the under-five population).

[43] One cultural factor, however, can be measured. Ramalingaswami c.s. argued"...that girls and women in South Asia are less well regarded and cared for than in sub-Saharan Africa...." (Ramalingaswami *et. al.* 1996: p.12). The data on malnutrition disaggregated by gender does not generally support this (UNICEF 1993a; UNICEF 1993b). In India and Pakistan, the prevalence of underweight and stunting is higher among males. In Bangladesh and Sri Lanka, however, the reverse is the case.

some validity to this thesis in the present developing countries, but there are also notable differences with the experience of the now-developed countries in the nineteenth century.

Firstly, the explanatory mechanism, suggested by Komlos suggests that stunting and GDP per capita follow an inverted-U shape. We could, however, not find much evidence for this. On the other hand, there is no perfect correlation between stunting and GDP per capita. About 55 per cent of the variance of stunting across countries could be explained by GDP per capita alone. Part of the deviations between GDP per capita and stunting can be explained by some other variables as the Komlos-explanation suggests. But there are differences with the historical experience of the now-developed countries in the nineteenth century.

Secondly, urbanization probably had a negative effect on anthropometric indicators in the nineteenth century. In contrast, if urbanization has any effect in developing countries, the effect is positive. Stunting is marginally (and insignificantly) lower in urban areas in developing countries because of the higher access to health and sanitation services and safe water.

Thirdly, the infant mortality rate is significantly and positively correlated with stunting. This important effect might perhaps be related to the availability of new and relatively cheap medical technology in developing countries. Vaccinations and other advances have reduced the incidence of diseases and reduced therefore stunting.

* * * * *

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Appendix 1. *Variable Abbreviations, Definitions, Data Sources and Methodological Issues*

Table A1 *Variable Abbreviations, Definitions and Data Sources*

Variable	Definition	Source
STNT	percentage of stunted children under 5 years of age(below 2 SD from reference median)	UNICEF (see: references)
GDP/C (PPP)	GDP per capita at purchasing power parities of 1985	Penn World Table, 5.6a
GDP/C (ER)	GDP per capita at 1987 prices and exchange rates	World Bank, World Tables, CD-ROM
IMR	infant mortality rate	United Nations (1995)
LE	life expectancy at birth	United Nations (1995)
URBAN	percentage of population in urban areas	World Bank, World Tables, CD-ROM
EQUALITY	income share of poorest 40 per cent of households	World Bank, World Tables, CD-ROM UNDP, Human Development Report, 1996
AGR/GDP	share of agriculture in GDP (at factor prices)	World Bank, World Tables, CD-ROM
CALORY	per capita daily supplies of kilocalories	FAO, data diskette
PROTEIN	per capita daily supplies of protein in grams	FAO, data diskette
AID	per capita daily supplies of food aid in grams	World Bank, World Tables, CD-ROM
D+bias	D+bias = 0 for countries where stunting is not measured for part of first year, or where children older than 5 years are also measured	
D-bias	D-bias = 1 for countries where stunting is not measured for part of the ages between 1 and 5 years	
DSAsia	dummy for South Asia: South Asia = 1	
DEAsia	dummy for East Asia: East Asia = 1	
DLatin	dummy for Latin America and the Caribean: Latin America and the Caribean = 1	

(Table A1 is continued on the next page)

Table A1 (continued) *Variable Abbreviations, Definitions and Data Sources*

Variable	Definition	Source
DT1	dummy for the period of the first survey (if there is more than 1 survey)	
DT2	dummy for the period of the second survey	
DT3	dummy for the period of the third survey	
DT4	dummy for the period of the fourth survey	
K/L	capital stock per capita	King and Levine (1994)
H	human capital stock	Barro and Lee (1993)
L	population in (1000s)	World Bank, World Tables, CD-ROM

NOTES ON METHODOLOGICAL ISSUES

If the stunting data refer to more than one year, variables such as GDP per capita, food supplies and urbanization rates were averaged for the corresponding years.

GDP per capita (GDPCER)

For the most recent years, growth rates of real GDP per capita from UN/DESIPA data bases were applied to real GDP per capita for the most recent year available from World Bank.

Infant mortality rate and life expectancy (IMR, LE)

The infant mortality rate and life expectancy in United Nations (1995) refer to five-year periods. If the stunting data, for example, refer to 1986, the IMR and LE of 1985-90 are used. If STNT refers to 1985, the average for the periods 1980-85 and 1985-1990 is used.

Income inequality (EQUALITY)

Data are from households surveys closed in time to anthropometric survey. In a few cases, surveys were far removed in time (more than a decade) from the anthropometric survey. Moreover, anthropometric surveys have been conducted more frequently than household surveys in which case the same observation for EQUALITY has been used for more than one year. It is thus not surprising that we attach only limited value to this data set.

Food Supply (CALORY, PROTEIN)

Food supply = food production + food imports - food exports. This is adjusted for changes in stocks, food used for seed and animal feed and for waste and industrial non-food uses, the result is called the food supply available for consumption. No correction is made for food losses and wastage at the retail and household level. The extent of overestimation is, however, likely to be relatively small in developing countries although more significant in developed countries (FAO, 1996, pp. 40, 129).

Share of agriculture in GDP (AGR/GDP)

If GDP and agricultural GDP were not available at factor prices, market prices were taken.

Capital stock (K/L, H)

Data of capital stock per capita (K / L) from King and Levine (1994) and human capital stock (H) from Barro and Lee (1993) are retrieved from World Bank Web site on the Internet. The measure of H which performed best was the average years of secondary schooling of total population.

* * * * *

Appendix 2: *Data*

	Country	Year	STUNTING[a]	months[b]	GDP/C[d]	IMR	LE	URBAN	INEQ.
Eastern & Southern Africa									
1	Botswana	1987	44.3	0-59	1339	54	62.4	20.5	6.0
2	Burundi	1987	48.1	3-36	225	111	49.2	5.6	
3	Burundi	1994	42.6	0-59	181	102	50.2		
4	Eritrea	1993	66.0	?		105	50.4		
5	Ethiopia	1982*	(42.1)	0-59		161	39.9	10.9	21.3
6	Ethiopia	1992*	(64.2)	6-59	141	119	47.5	12.7	21.3
7	Kenya	1978-79	35.4	0-59	361	88	53.4	15.0	9.0
8	Kenya	1982*	(38.2)	3-59	365	81	56.0	17.5	10.1
9	Kenya	1987*	(32.2)	0-59	373	73	57.4	21.3	10.1
10	Kenya	1995	33.6	6-60	378	68	55.0		10.1
11	Lesotho	1976	41.4	0-59	184	121	52.9	11.3	9.3
12	Lesotho	1981	26.1	0-59	236	100	55.5	13.9	9.3
13	Lesotho	1994	32.9	?	319	79	60.5		9.3
14	Madagascar	1983-84	27.9	0-23	255	130	51.5	20.4	13.7
15	Madagascar	1995	47.3	0-59	213	93	57.8		13.7
16	Malawi	1981	56.2	6-59	154	163	45.0	9.4	
17	Malawi	1992	48.6	0-59	128	143	45.6	12.5	
18	Mauritius	1985	21.5	0-59	1487	24	67.7	41.4	14.0
19	Namibia	1990*	(30.0)	6-60	1479	68	56.3	31.9	
20	Namibia	1992	28.4	0-59	1600	60	58.8	34.1	
21	Rwanda	1976	36.6	0-59	289	133	45.0	4.1	22.8
22	Rwanda	1982-83*	(37.7)	0-60	353	124	46.5	5.0	22.8
23	Rwanda	1991-92*	(52.2)	0-60	319	110	47.3	5.8	22.8
24	Rwanda	1992	48.3	?	320	110	47.3	5.8	22.8
25	Seychelles	1988	5.1	0-59	3822	18	69.7	47.8	
26	South Afr.	1994	23.0	6-71	2086	53	62.9		9.1
27	Swaziland	1983-84*	(30.3)	3-59	822	94	52.5	21.0	
28	Tanzania	1985		0-59	146	94	51.8	17.5	8.1
29	Tanzania	1988			157	89	52.5	19.5	8.1
30	Tanzania	1991-92	46.7	0-59	170	85	52.1	22.2	8.1
31	Uganda	1988*	(44.5)	0-60	431	120	46.8	10.7	42.0
32	Uganda	1988-89*	(44.5)	0-60	439	120	46.8	10.9	42.0
33	Zambia	1970-72*	(37.0)	0-59	444	100	47.3	31.1	11.1
34	Zambia	1990*	(54.1)	6-60	291	109	52.0	42.0	15.2
35	Zambia	1992	39.6	0-59	273	104	48.9	42.0	15.2
36	Zimbabwe	1988	29.0	3-60	637	69	56.9	27.2	11.0
37	Zimbabwe	1994	21.4	?	616	67	53.7		11.0
West & Central Africa									
38	Burkina F.	1993	29.4	?	242	130	47.4	23.5	
39	Cameroon	1977-78	35.6	3-48	779	102	48.5	29.6	
40	Cameroon	1991	24.4	0-59	831	63	56.0	41.2	
41	Cape Verde	1983	14.9	0-59	498	66	60.6	29.2	
42	Cape Verde	1985	25.8	12-72	543	62	61.6	33.0	
43	Congo	1987	20.5	0-59	1126	84	52.2	49.9	
44	Cote d'Iv.	1986	17.2	12-59		97	51.9	38.2	13.0
45	Ghana	1987-88	30.5	0-59	376	90	54.0	33.3	17.4
46	Ghana	1993	26.0	1-35	402	81	56.0	35.4	18.3
47	Guinea B.	1978-80			178	176	37.5	16.8	8.6

	Country	Year	STUNTING[a]	months[b]	GDP/C	IMR	LE	URBAN	INEQ.
48	Liberia	1976	36.9	0-59	718	167	49.5	31.2	11.0
49	Mali	1987	24.4	3-36	253	169	44.0	22.1	
50	Mauritania	1988	34.0	0-59	486	110	49.5	43.4	14.2
51	Mauritania	1990	52.3	?	472	110	49.5	46.8	14.2
52	Mauritania	1990-91	56.9	0-59	473	101	51.5	48.2	14.2
53	Niger	1985	37.7	0-59	325	141	43.5	13.8	
54	Niger	1992	32.3	?	276	124	46.5	15.9	
55	Nigeria	1990	43.1	0-59	358	88	49.4	35.2	15.2
56	Sao Tome&P	1986	26.0	0-59	531	74	65.2	38.5	
57	Senegal	1986	22.7	6-36	675	76	47.3	38.3	10.5
58	Senegal	1991-92	29.1	6-59	669	68	49.3	40.8	10.5
59	Senegal	1993	21.7	?	630	68	49.3	41.3	10.5
60	Sierra L.	1974-75	34.2	0-59	168	193	35.0	20.8	15.0
61	Sierra L.	1977-78	42.8	0-59	152	192	35.2	23.1	15.0
62	Sierra L.	1989-90	34.7	0-59	146	179	37.0	32.2	15.0
63	Togo	1977	32.9	6-59	423	117	48.0	18.9	
64	Togo	1988	29.6	0-36	400	94	53.0	27.7	
65	Zaire	1975	43.3	0-59	307	122	47.1	29.5	
Middle East & North Africa									
66	Algeria	1987	13.9	0-72	2796	67	65.0	49.2	17.9
67	Algeria	1992	18.1	0-59	2555	55	68.9	53.3	17.9
68	Djibouti	1990	22.2	0-59	716	119	47.7	80.7	
69	Egypt	1978	38.8	6-59	483	131	54.1	43.7	14.8
70	Egypt	1988	30.8	3-36	724	81	61.1	43.9	14.8
71	Egypt	1990	30.0	0-59	734	74	62.4	43.9	14.8
72	Egypt	1992	24.4	?	723	67	63.6	44.3	14.8
73	Iran	1980*	(50.4)	0-59	2970	89	59.6	49.6	
74	Iraq	1991	21.8	0-59	781	58	66.0	72.4	
75	Jordan	1990	19.3	0-59	1507	40	66.9	68.0	16.8
76	Jordan	1991	15.9	pre-school	1374	36	67.9	68.7	16.8
77	Kuwait	1983-84	12.4	0-59	12302	25	71.6	93.1	
78	Morocco	1987	25.5	0-36	823	82	60.7	44.8	22.8
79	Morocco	1992	22.6	?	886	68	63.3	47.0	17.1
80	Oman	1991	21.8	12-72	5514	30	69.6	11.9	
81	Oman	1995	12.4	6-84	5773	30	69.6		
82	Sudan	1987*	(32.1)	0-59	718	85	51.0	21.6	
83	Sudan	1993	33.0	0-59		78	53.0	23.8	
84	Syria	1993	27.0	0-59		39	67.1	51.5	
85	Tunisia	1973-75	39.5	0-59	925	120	55.6	48.7	15.0
86	Tunisia	1988	18.2	3-36	1256	49	65.6	54.1	16.3
87	Turkey	1993	20.5	?	1893	65	66.5	65.6	
88	Yemen(AR)	1979	62.7	3-59		128	48.7	19.4	
89	Yemen(PDR)	1982-83	33.9	0-65					
90	Yemen	1991-92	44.1	0-59		119	50.2	30.8	
East Asia & Pacific									
91	China	1987*	(32.1)	0-59	234	50	67.1	24.0	17.4
92	China	1990	32.1	0-60	269	47	67.8	26.2	17.4

	Country	Year	STUNTING[a]	months[b]	GDP/C	IMR	LE	URBAN	INEQ.
93	Cambodia	1994	38.4	?		116	51.6		
94	Indonesia	1987			447	75	60.2	27.9	21.2
95	Laos	1984	40.1	0-59	285	122	46.0	15.4	
96	Laos	1994	47.3	?	349	97	51.0		
97	Mongolia	1992	26.4	0-48	1384	60	63.7	59.2	
98	Myanmar	1980-81	47.9	0-36	266	106	52.2	24.0	
99	Myanmar	1983-85	49.7	0-36	291	106	52.2	24.0	
100	Myanmar	1990		0-36	238	91	56.4	24.8	
101	Myanmar	1991	40.4	0-35	231	84	57.6	25.1	
102	Papua N.G.	1984		0-59	831	72	51.9	13.8	
103	Philippines	1971-75	55.1	0-59	541	71	57.8	34.3	14.0
104	Philippines	1982	42.0	0-59	693	60	61.9	39.7	15.2
105	Philippines	1987	38.6	0-59	582	53	64.0	45.3	16.6
106	Philippines	1989-90	37.2	0-59	635	53	64.0	48.8	16.6
107	Singapore	1970-77	10.6	0-71	3671	17	69.9	100.0	15.0
108	Thailand	1987	22.4	3-36	962	40	67.5	18.2	15.5
109	Vanuatu	1983	19.1	0-59	914	70	60.0	18.1	
110	Viet Nam	1986*	(59.7)	0-59	537	47	62.6	19.7	19.2
111	Viet Nam	1987-89*	(49.1)	0-59	566	47	62.6	19.8	19.2
112	Viet Nam	1994	46.9	?	755	42	65.2		19.2
South Asia									
113	Bangladesh	1985-86	67.5	6-59	166	119	52.8	13.7	22.9
114	Bangladesh	1989-90	64.6	6-59	179	119	52.8	15.7	22.9
115	Bangladesh	1992	62.8	6-59	189	108	55.6	16.7	22.9
116	Bhutan	1987-88	56.1	0-60		143	48.2	5.0	
117	India	1975-79*	(78.6)	12-71		129	52.9	22.0	16.2
118	India	1988-90*	(65.1)	12-71	363	93	57.9	25.3	21.3
119	Maldives	1981	48.1	0-59		94	57.1	23.0	
120	Nepal	1975	68.6	0-59	150	146	44.6	5.0	12.6
121	Nepal	1995	63.5	6-36	205	93	55.0		22.0
122	Pakistan	1985-87	49.1	1-59	311	105	59.0	30.2	19.0
123	Pakistan	1990-91	50.0	0-59	353	91	61.5	32.5	21.3
124	Sri Lanka	1975-76	50.9	6-59	283	44	66.8	22.0	13.3
125	Sri Lanka	1987*	(27.5)	3-36	411	24	70.6	21.2	13.3
126	Sri Lanka	1988-89*	(36.4)	0-59	418	24	70.6	21.3	22.0
127	Sri Lanka	1993	23.8	?	492	18	71.9	22.0	22.0
Americas & Caribbean									
128	Antigua	1981	6.6	0-59	3112	30	72.2	34.7	
129	Barbados	1981	7.4	0-59	5297	17	73.2	40.7	19.0
130	Bolivia	1981	42.7	0-59	865	109	53.7	46.5	13.0
131	Bolivia	1989	38.3	3-36	710	90	56.9	54.8	15.3
132	Bolivia	1994	28.3	?	780	75	59.4		15.3
133	Brazil	1975	32.0	0-59	1666	85	60.8	61.2	9.4
134	Brazil	1989	15.5	0-59	2079	64	64.8	73.8	7.0
135	Chile	1986	9.6	0-71	1580	18	72.6	82.7	10.5
136	Chile	1994	2.6	0-71	2359	16	73.8		16.5
137	Colombia	1977-80	22.4	0-59	1048	59	64.0	63.0	11.2
138	Colombia	1986	22.7	3-36	1135	40	68.3	67.6	12.7

	Country	Year	STUNTING[a]	months[b]	GDP/C	IMR	LE	URBAN	INEQ.
139	Colombia	1986-89	16.6	0-59	1174	40	68.3	69.4	12.7
140	Costa Rica	1982	7.8	0-59	1515	19	73.8	43.8	11.6
141	Costa Rica	1992	7.8	?	1790	14	76.3	48.1	13.1
142	Cuba	1987				13	74.6	72.0	
143	Dominica	1985	5.9	0-23	1524	16	71.8		
144	DominicanR.	1986	20.8	6-36	725	55	68.2	56.6	12.1
145	DominicanR.	1991	19.4	0-59	765	42	69.6	61.2	12.1
146	Ecuador	1987	34.0	0-59	1103	57	67.0	52.6	13.0
147	El Salvador	1975*	(50.9)	6-59	1085	93	58.0	40.4	
148	El Salvador	1988	29.9	0-59	904	59	62.4	43.4	15.8
149	El Salvador	1993	22.8	?	984	46	66.4	44.6	15.8
150	Guatemala	1987	57.9	3-36	840	59	62.0	38.6	7.9
151	Guyana	1971	26.6	0-59	553	79	60.0	29.5	
152	Guyana	1981	20.7	0-59	589	63	61.1	30.7	
153	Guyana	1993	20.7	?	482	48	65.2	34.6	
154	Haiti	1978	39.6	3-59	384	121	50.7	22.9	
155	Haiti	1990	33.9	?	339	92	55.7	28.6	
156	Honduras	1987	33.9	0-59	933	53	65.4	38.9	8.7
157	Honduras	1992	36.3	?	952	43	67.7	42.0	8.7
158	Jamaica	1978	12.1	0-59	1421	26	70.1	45.7	15.9
159	Jamaica	1989	8.7	0-59	1402	17	72.5	51.0	15.9
160	Jamaica	1993	6.3	0-59	1466	14	73.6	52.8	15.9
161	Mexico	1988	22.3	0-59	1758	42	69.3	71.4	11.9
162	Nicaragua	1980-82	21.8	0-59	1381	86	59.3	54.7	12.2
163	Nicaragua	1993	23.7	pre-school	816	52	66.7	61.7	12.2
164	Panama	1980	22.0	0-59	2255	33	69.9	49.7	7.2
165	Panama	1992	9.0	12-59	2255	25	72.8	52.3	8.3
166	Paraguay	1990	16.6	0-59	1004	40	69.4	48.9	16.4
167	Peru	1975	39.7	0-71	1367	105	56.5	61.5	16.1
168	Peru	1984	37.8	0-71	1183	82	60.2	66.8	16.1
169	Peru	1990-91	36.5	?	992	70	66.0	70.3	14.1
170	Peru	1991-92	36.5	0-59	975	64	66.0	70.8	14.1
171	St. Lucia	1976	10.8	0-59				41.2	
172	Trinidad&T.	1976	12.4	0-59	4101	38	67.1	63.0	13.3
173	Trinidad&T.	1987	5.0	3-36	4032	24	70.4	67.4	13.3
174	Uruguay	1987	15.9	0-59	2410	24	72.0	87.9	15.4
175	Venezuela	1981-82	6.4	0-59	2870	34	68.7	84.5	14.6
176	Venezuela	1981-87	6.1	0-60	2687	27	69.6	88.6	13.9

Country	Year	CALO-RIES	PRO-TEIN	AGR/GDP	POPU-LATION[c]	AID	K/L	Human K
Eastern & Southern Africa								
Botswana	1987	2253	67.4	5.1	1153	38.2		0.26
Burundi	1987	2023	62.6	55.1	5038	0.4	542	
Burundi	1994			50.8	6209			
Eritrea	1993			13.1	3345			
Ethiopia	1982*	1758	59.1	54.4	38205	5.0	147	
Ethiopia	1992*	1610	51.4	64.4	50339	19.7		
Kenya	1978-79	2220	61.2	35.8	15650	0.6	1221	0.12
Kenya	1982*	2122	55.3	33.4	17895	7.1	1241	0.39
Kenya	1987*	2040	54.8	31.5	21363	5.0	1167	0.27
Kenya	1995							
Lesotho	1976	2256	63.9	27.2	1216	14.8	516	0.17
Lesotho	1981	2132	54.8	27.1	1381	31.9	1013	0.18
Lesotho	1994			13.7	1996			
Madagascar	1983-84	2417	57.3	35.5	9568	11.2	813	
Madagascar	1995							
Malawi	1981	2285	65.9	36.0	6383	2.7	752	0.09
Malawi	1992	1825	50.6	28.3	10036	25.8		
Mauritius	1985	2686	63.6	15.3	1016	8.9	4295	0.92
Namibia	1990*	2187	61.1	11.8	1349	3.0		
Namibia	1992	2134	62.1	10.3	1422	4.2		
Rwanda	1976	2081	54.6	54.1	4530	2.2	203	0.10
Rwanda	1982-83*	2151	54.0	41.3	5592	2.3	256	0.09
Rwanda	1991-92*	1841	44.4	43.0	7263	1.3		
Rwanda	1992	1821	43.9	43.2	7358	1.4		
Seychelles	1988	2335	64.0	4.7	68			
South Afr.	1994			4.7	40555			
Swaziland	1983-84*	2530	64.6	19.4	583	12.0	5727	0.32
Tanzania	1985	2300	58.2	56.7	21797	5.7	799	0.15
Tanzania	1988	2208	55.1	62.7	24005	3.2	772	
Tanzania	1991/92	2072	50.6	54.5	26766	0.7		
Uganda	1988*	2156	48.6	56.3	15953	1.8		0.08
Uganda	1988/89*	2214	50.4	56.4	16150	1.4		
Zambia	1970-72*	2234	64.8	13.3	4313	0.1	5498	0.22
Zambia	1990*	2088	53.5	20.6	8150	0.4		
Zambia	1992	1931	50.6	23.8	8649	38.7		
Zimbabwe	1988	2205	55.2	15.7	9268	1.5	1974	0.23
Zimbabwe	1994				11002			
West & Central Africa								
Burkina F.	1993				9772	3.1		
Cameroon	1977-78	2378	59.2	36.1	8072	0.6	1016	0.25
Cameroon	1991	1954	47.8	25.9	11849	0.8		
Cape Verde	1983	2713	66.6	11.2	301	116.1		
Cape Verde	1985	2704	63.6	12.7	310	161.3		
Congo	1987	2318	47.7	12.4	2041	0.5		1.03
Cote d'Iv.	1986	2682	56.9	31.2	10311	0.1	1488	
Ghana	1987-88	2168	46.6	50.1	13889	6.3	653	0.93
Ghana	1993			47.6	16446	4.6		
Guinea B.	1978-80	2019	42.3	51.8	759	25.4	1738	0.05

Country	Year	CALO-RIES	PRO-TEIN	AGR/GDP	POPU-LATION[c]	AID	K/L	Human K
Liberia	1976	2254	41.3	29.8	1659	1.2	4213	0.43
Mali	1987	2091	59.4	45.2	7780	9.9	346	0.06
Mauritania	1988	2484	78.4	32.7	1905	28.4	1721	
Mauritania	1990	2531	77.7	29.6	2003	35.9		
Mauritania	1990-91	2574	79.3	29.2	2029	42.6		
Niger	1985	2308	60.4	38.3	6608	33.4	669	0.06
Niger	1992	2257	61.1	39.4	8270	4.8		
Nigeria	1990	2124	43.0	32.7	96154	0.0		
Sao Tome&P	1986	2070	42.9	22.4	106	56.6		
Senegal	1986	2523	77.3	22.3	6555	17.8	870	0.31
Senegal	1991-92	2274	64.9	19.8	7610	6.6		
Senegal	1993			20.1	7902	9.0		
Sierra L.	1974-75	1938	44.5	29.8	2902	2.6	323	0.40
Sierra L.	1977-78	2043	44.7	34.3	3080	1.8	301	0.40
Sierra L.	1989-90	1877	39.4	37.3	4097	9.2		0.44
Togo	1977	1982	42.8	39.2	2412	2.9	1149	0.19
Togo	1988	2165	50.5	37.8	3321	4.8	1253	0.56
Zaire	1975	2174	36.1	17.7	23251	0.0	386	0.07
Middle East & North Africa								
Algeria	1987	2803	75.6	12.4	23059	0.2	8434	0.44
Algeria	1992	2897	75.6	13.7	26096	0.7		
Djibouti	1990	2385	59.8	2.9	517	11.6		
Egypt	1978	2926	74.3	25.3	41716	41.5	604	0.46
Egypt	1988	3280	86.0	19.3	51170	32.2	1030	
Egypt	1990	3336	87.3	18.3	53214	22.7		
Egypt	1992	3335	87.3	18.1	55340	18.5		
Iran	1980*	2656	68.1	18.0	39254		6035	0.69
Iraq	1991	1838	44.8		18529	0.2		0.76
Jordan	1990	2756	71.9	8.1	3278	76.3		1.34
Jordan	1991	2903	78.2	8.5	3664	131.3		
Kuwait	1983-84	3071	91.9	0.4	1609		29932	2.96
Morocco	1987	2928	80.1	15.4	22790	26.8	1858	
Morocco	1992	2984	80.9	14.9	25378	7.8		
Oman	1991			3.7	1827			
Oman	1995							
Sudan	1987*	2172	60.8	36.1	22661	39.3		0.28
Sudan	1993				26641	8.9		
Syria	1993				13696	1.1		
Tunisia	1973-75	2628	69.4	21.7	5511	17.0	3023	0.36
Tunisia	1988	3080	83.6	13.4	7700	53.9	3625	0.73
Turkey	1993			16.2	59597	0.0		
Yemen(AR)	1979					4.4		0.03
Yemen(PDR)	1982-83					4.2		.05
Yemen	1991-92	2158	55.7	18.5	12190	8.5		
East Asia & Pacific								
China	1987*	2592	62.5	31.0	1083998	0.5		
China	1990	2685	65.8	29.3	1135160	0.1		

Country	Year	CALO-RIES	PRO-TEIN	AGR/ GDP	POPU-LATION[c]	AID	K/L	Human K
Cambodia	1994				9968			
Indonesia	1987	2653	56.7	23.4	169478	2.2	3652	0.58
Laos	1984	2478	67.6		3513	0.6		
Laos	1994				4742			
Mongolia	1992	1899	69.0	31.8	2267	2.2		
Myanmar	1980-81	2351	60.8	47.0	34178	0.3	619	0.44
Myanmar	1983-85	2627	67.2	48.0	36773	0.1	711	0.59
Myanmar	1990	2550	63.1	57.3	41813			
Myanmar	1991	2577	64.5	58.8	42716			
Papua N.G.	1984	2429	48.9	40.5	3368		4839	0.20
Philippines	1971-75	1856	46.1	33.1	40763	5.9	2471	0.87
Philippines	1982	2194	52.3	25.3	50764	1.1	3896	1.15
Philippines	1987	2150	49.1	26.3	57035	6.1	3544	1.30
Philippines	1989-90	2352	54.5	23.5	60142	1.6		
Singapore	1970-77			8.3	2203	0.0	10604	1.12
Thailand	1987	2293	49.8	17.8	52520	0.6	3270	0.64
Vanuatu	1983	2664	64.4	30.8	126			
Viet Nam	1986*	2186	49.5	36.1	61199	0.3		
Viet Nam	1987-89*	2180	50	41.5	63895	1.3		
Viet Nam	1994			27.7	72500	0.0		
South Asia								
Bangladesh	1985-86	1939	42.0	43.4	99477	14.1	404	0.57
Bangladesh	1989-90	1982	42.8	39.3	107126	11.5		
Bangladesh	1992	2019	42.5	36.8	112885	12.0		
Bhutan	1987-88			45.6	1465	1.7		
India	1975-79*	2041	50.6	38.7	647395	1.5	1071	0.45
India	1988-90*	2308	57.0	31.5	827892	0.4	1228	0.81
Maldives	1981	2159	71.5		163			
Nepal	1975	1876	49.2	71.8	13006		478	0.03
Nepal	1995							
Pakistan	1985-87	2196	52.1	27.5	100949	4.2	1414	0.77
Pakistan	1990-91	2351	57.3	25.8	114502	3.4		
Sri Lanka	1975-76	2169	43.9	29.7	13721	14.6	2748	1.75
Sri Lanka	1987*	2217	46.9	27.0	16550	17.5	4476	1.84
Sri Lanka	1988-89*	2235	46.0	26.0	16884	18.7		
Sri Lanka	1993			24.6	17897	13.9		
Americas & Caribbean								
Antigua	1981	2324	70.4	6.4	61	0.0		
Barbados	1981	3132	89.7	7.6	250	0.0	12129	2.16
Bolivia	1981	2040	53.8		5470	10.1	3389	1.18
Bolivia	1989	1893	47.7		6488	14.6		1.27
Bolivia	1994				7237			
Brazil	1975	2529	59.8	12.1	108032	0.3	5774	0.60
Brazil	1989	2762	61.8	8.5	145687	0.1		0.88
Chile	1986	2462	64.9	7.4	12284	0.8	5379	1.71
Chile	1994				14044			
Colombia	1977-80	2404	51.6	24.8	25676	0.4	4741	1.13
Colombia	1986	2427	53.9	19.8	30416	0.2	5371	1.32

Country	Year	CALO-RIES	PRO-TEIN	AGR/ GDP	POPU-LATION[c]	AID	K/L	Human K
Colombia	1986-89	2476	55.5	19.3	31485	0.9	5413	1.32
Costa Rica	1982	2507	58.2	27.7	24211	8.6	5131	0.84
Costa Rica	1992	2883	67.3	16.4	3160			
Cuba	1987	3136	73.9		10298			
Dominica	1985	2615	64.5	27.9	72	0.0		0.63
DominicnR	1986	2393	49.8	21.7	6517	19.2	3604	0.83
DominicnR	1991	2259	50.7	17.5	7247	0.8		
Ecuador	1987	2490	49.8	17.3	9548	5.6	6440	1.41
El Salvador	1975*	2125	52.3	24.9	4085	1.0	1292	0.41
El Salvador	1988	2356	56.2	13.9	4994	35.4	1471	0.51
El Salvador	1993			8.6	5517	23.7		
Guatemala	1987	2252	55.3	26.0	8435	22.9	1914	0.41
Guyana	1971	2280	55.7	20.4	714	4.2	5723	0.38
Guyana	1981	2567	66.0	23.4	765	6.5	6190	0.71
Guyana	1993			36.2	816	71.1		
Haiti	1978	2053	47.7		5175	10.6	582	0.26
Haiti	1990	1774	41.5	31.8	6486	27.6		0.39
Honduras	1987	2135	49.6	20.9	4451	30.8	1588	0.67
Honduras	1992	2305	54.4	20.2	5175	30.1		
Jamaica	1978	2736	67.9	8.6	2084	60.0	7106	0.74
Jamaica	1989	2564	61.9	7.0	2375	153.7		1.20
Jamaica	1993			7.7	2472	83.3		
Mexico	1988	3112	79.3	8.6	80795	0.4	10135	0.82
Nicaragua	1980-82	2321	60.4	24.2	2883	26.8	4644	0.39
Nicaragua	1993			36.3	4114	20.7		
Panama	1980	2234	57.2	10.7	1950	1.0	7482	1.56
Panama	1992	2242	59.2	12.0	2489	0.4		1.79
Paraguay	1990	2610	66.1	29.9	4317	0.7		0.91
Peru	1975	2288	59.0	17.6	15161	2.4	4625	0.95
Peru	1984	2065	53.9	10.5	19057	10.9	5203	1.48
Peru	1990-91	1881	50.4	11.0	21799	13.0		
Peru	1991-92	1910	50.6	11.0	22225	18.6		
St. Lucia	1976	2092	53.4		109		0.28	
Trinidad&T.	1976	2742	73.0	3.9	1026			1.11
Trinidad&T.	1987	2982	75.3	2.6	1190			1.75
Uruguay	1987	2616	82.3	16.4	3042		11060	1.85
Venezuela	1981-82	2682	71.1	5.2	15679		12114	1.20
Venezuela	1981-87	2641	67.6	5.9	16732		11272	1.35

NOTES TO DATA APPENDIX:

[a] Surveys for subnational samples are between parentheses. The year is marked by an asterisk. Some anthropometric surveys were conducted without a measurement of stunting. They obviously contain no data in the STUNTING column but are nonetheless included.

[b] Age at which children are measured (in months).

[c] In 1000s.

[d] At exchange rates.

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