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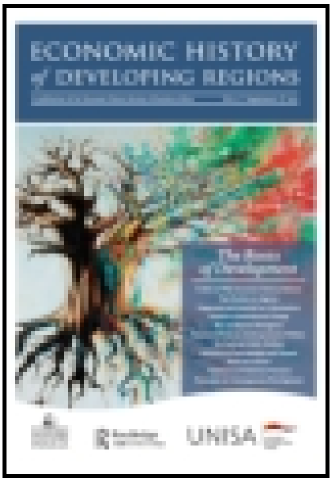

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Growing Tall but Unequal: New Findings and New Background Evidence on Anthropometric Welfare in 156 Countries, 1810-1989

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GROWING TALL BUT UNEQUAL: NEW FINDINGS AND NEW BACKGROUND EVIDENCE ON ANTHROPOMETRIC WELFARE IN 156 COUNTRIES, 1810–1989

Joerg Baten[1] and Matthias Blum[2]

ABSTRACT

This is the first initiative to collate the entire body of anthropometric evidence during the 19th and 20th centuries, on a global scale. By providing a comprehensive dataset on global height developments we are able to emphasise an alternative view of the history of human well-being and a basis for understanding characteristics of well-being in 156 countries, 1810–1989.

Keywords: welfare, anthropometric history, gross domestic product estimation

JEL classification: N10, N30, O10

1. INTRODUCTION

How can the study of economic history contribute to the understanding of long-run development processes? We argue that the first step is to reconstruct appropriate indicators for welfare development. If direct indicators cannot be constructed, proxy indicators are helpful. Moreover, given that there is no indicator without problems, a comparison of different indicators based on different sources can yield reliable information. After development trends have been established as a first step, analysis of various development policies or institutional setups can follow. We present here for the first time welfare trends based on anthropometric indicators for 156 countries between the Napoleonic Wars and the 1980s.

Human stature is now a well-established indicator for the biological standard of living, positively correlated as it is, along with good health and longevity, with a

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nutritious diet.[3] In the 1980s Robert F. Fogel, Richard Steckel, and John Komlos pioneered its use in the field of economic history, and a large body of literature in this and other fields has emerged since (Blum and Baten 2011; Floud, Wachter and Gregory 1990; Harris 1994; Komlos and Baten 2004; Steckel 2009). Anthropometric studies of individual countries have made a significant contribution to social-welfare economics over the past several decades, and have in turn served as the basis for a number of collective analyses, in which several such studies are presented and compared (e.g., Komlos and Baten 1998; Steckel and Floud 1997). This is the first attempt, however, to collate the entire body of anthropometric evidence, on a global scale. By providing a comprehensive dataset on global height developments we are able to emphasise an alternative view of the history of human well-being and a basis for understanding characteristics of well-being with other indicators than purchasing-power related ones such as GDP per capita.

In estimating height trends by world regions each of which comprises several nations, we aim to incorporate the maximum of previously published research.[4] Height estimates are organised and analysed on the basis of birth decades wherever possible. However, continuous series are available for only some of these countries. Moreover, the series on individual countries, even some of those that are based on a substantial underlying number of cases, are prone to measurement error, since the the samples' regional and social composition are difficult to ascertain, and may introduce bias. To account for this potential bias, all problematic measurement issues are denoted with dummy variables, and their degree of bias will be carefully analysed. For the estimation of world-region trends, data for a large number of countries is collected, with the result that most measurement errors are cancelled out. This unprecedented compilation project should facilitate further efforts of height analysis, providing as it does a realistic ground for further comparisons. As a main result, we find that regional height levels around the world were fairly uniform throughout most of the 19th century, with two exceptions: above-average levels in Anglo-Saxon settlement regions and below-average levels in Southeast Asia. Differences in welfare development were quite limited during the early and mid 19th century. After 1880, substantial divergences began to differentiate other regions – making the world population taller, but more unequal.

[3] The term "biological standard of living" was coined by Komlos in 1987. One of the rare exceptions to the height-longevity correlation is that of the relatively short, protein-deprived, Japanese prior to the economic boom of the 1960s; their longevity values were above average thanks to their high valuation of personal hygiene, the importance of which was underscored by health-related instruction in schools.

[4] We include all countries with more than 400,000 inhabitants for which evidence is available, using 1990 borders, in order to permit comparison with Maddison's 2001 GDP estimates. Following this strategy, we conlude that at this point in time 156 different countries can be taken into account.

If economists are coming to use height as a valid complement to conventional welfare indicators, this is because it has some specific advantages. A given income level permits the purchase of a given quality as well as quantity of food and medical services, and is thereby correlated with health, which in turn is correlated with height. However, this income-height correlation is not one-to-one, modified by important inputs not traded in the marketplace but provided as public goods, such as infant-nutrition programs and public hospitals, which account for slight deviations between purchasing power-based and height-based measures of biological well-being. Moreover, income fails to account for discrepancies within households. While it cannot account for every potential variable in a given population, the anthropometric approach permits economists and economic historians to capture important aspects of the biological standard of living (Komlos 1985), particularly in developing countries, hitherto neglected because reliable data were lacking. The well-known Maddison data set (2001), for example, provides only rough estimates for many such countries prior to 1910. While height is not without its deficiencies as a measure of the standard of living of a given population, it generates insights into global changes, and is particularly valuable as a countercheck as well as a complement to conventional indicators, permitting more reliable results than might otherwise be the case.

Life expectancy is among the many health indicators with which height is positively correlated. This correlation further underlines the importance of height research. Having analysed height data for the birth cohorts of 1860, 1900, and 1950, Baten and Komlos (1998) concluded that every centimetre above and beyond a given population's average height translates into a life-expectancy increase of 1.2 years.[5] Thus a mere half-centimetre deviation from the average is significant, representing as it does six months of life. The correlation between height and longevity is even closer among children (Martorell 1985).

The question of what role genetics, as well as nutrition, may play in determining a given population's average height was often raised in the early years of anthropometric research. It turns out that while genes are a key determinant of an individual's height, when it comes to groups of individuals genetic deviations from the mean cancel each other out. Moreover, there is considerable evidence that it is environmental conditions, not genes, which account for most of today's height gap between rich and poor populations, including those inhabiting a single nation. Habicht et al. (1974), for example, found that the height gap between the rich and poor sectors of a less-developed country (LDC), Nigeria, was even wider than that between an LDC's elite and a reference population in the United States.[6] Fiawoo (1979), in his study of Ghana,

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[5] The third cohort comprises those who have attained adulthood at some point between the 1970s and the present. The authors found any variation in the coefficient among the three cohorts to be negligible.

[6] The following review of the literature is based on Moradi and Baten 2005.

reached the same conclusion as Habicht, as did Eksmyr (1970), working with data on several Ethiopian ethnic groups, and Graitcer and Gentry (1981), when they considered Egypt, Haiti, and Togo. What is more, the height-distribution percentiles for children from rich families in this last study are in line with those for a rich country, namely the United States. Of course, not all height differentials are due exclusively to environmental conditions: African bushmen and pygmies, for example, spring to mind, although they account for only a small percentage of their respective nations' populations. However, after taking into account availability of protein availability, disease environment, lactose tolerance, and food preferences (especially in those countries which could afford the choice) the height impact of "race" seems rather small.[7]

2. METHODOLOGICAL ISSUES

How can we estimate the world height trend over a period spanning nearly two centuries? To compensate for the fact that until the middle of the 20th century data are scarce for countries where poverty and illiteracy prevailed, we solicited a large number of recent anthropological measurements, with the aim of representing 164 countries, but were obliged to exclude eight for lack of evidence (Table 1, Appendix).[8] Needless to say, in some cases only a few birth decades are documented, and certain height estimates are compromised by measurement errors. But we have been as accurate as possible under the circumstances, recording height by province whenever possible, and adjusting our calculations to take into account any modifications of national borders. Only certain combinations of countries and birth decades are sufficiently well documented to contribute to our estimates for world regions and half centuries; for instance, no evidence is available for the Middle East and North Africa in the early 19th century, in large part because of the absence of precise height measurements in Ottoman Empire military data (Table 2).[9] In most other world regions, however, army data were available for the early 19th century. The year 1950 marks a turning-point because from that moment on population censuses, health surveys, and similar sources include data on women – in fact, considerably more than on men – because institutions other than the military, particularly those related to the health sciences, begin to take interest in them. The fact that there is a correlation, if not a simple one, between male and female heights is by now beyond dispute (Baten and Blum 2010) and it justifies our substituting one

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[7] Given space considerations, we cannot give a literature review here (see instead Baten and Blum 2010 and Steckel 2009).

[8] Bahrain, Cape Verde, Djibouti, the Palestinian Territory, Qatar, Reunion, the United Arab Emirates, and finally the trio Mayotte, Saint Helena, and Western Sahara (aggregated as in Maddison 2001).

[9] Instead of exact measurements the Ottoman army categorised each recruit as small, medium, or large as well as barefaced or bearded.

Table 2 Share of possible birth-decade and country observations covered by real data

	1810–1849	1850–1899	1900–1949	1950–1989
East Asia	0.89	0.94	0.98	0.99
East. Eur./Cntr. Asia	0.62	0.76	0.61	0.59
Latin America/Car.	0.61	0.66	0.79	0.74
Mid. East/N. Afr.	0.00	0.60	0.55	0.61
North America/Au/Nz	0.74	1.00	0.97	0.96
South Asia	0.24	0.95	0.71	0.87
Southeast Asia	0.30	0.94	0.84	0.54
Sub-Saharan Africa	0.19	0.40	0.77	0.86
Western Eur.	0.91	0.96	0.97	0.95

Sources: see Figure 1. Migrant heights were included in this Table.

set for another when need be. Objections to this strategy might be raised by those who accept the female-resiliency hypothesis, which holds that for biological reasons the average height of a given female population is more resistant to adverse conditions than that of their male counterparts. Some evidence of small pre-historic samples supported this hypothesis. However, drawing on the largest height sample available to date, Guntupalli (2005) has gone far to disprove this hypothesis for the last two centuries. Since the vast majority of historical height estimates are for males, we transform all estimates into male equivalents, estimating specific regression equations for each world region in order to account for potential differences (Baten and Blum 2010, Appendix A).

It is reasonable to assume that a teen-age conscript from a malnourished population has yet to reach his maximal height. In such a case we calculate what it will be by applying the method presented in Baten and Komlos (1998).[10] Migrants, evidently not representative of the population into which they were born, are another potential source of bias; in some cases, the possession of skills and money motivate a person to migrate (Humphries and Leunig 2009; Stolz and Baten 2012). Such an ambiguous situation obliged us to generate reasonable adjustments. For example, if we could determine (thanks to data permitting us to compare the average height of migrants with the average height of the source population) the

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[10] See the notes to Table 1 (Appendix) in the work cited. Baten and Komlos (1998) suggest the following adjustments, for societies in which males in their teens and twenties have yet to achieve their maximal height (as a rule, above 170 cm). Those who were 18 years of age were estimated to have 2.4 cm to go; those age 19 1.7 cm, those age 20 0.9 cm, those age 21 0.4, and finally those age 22 only 0.1 cm. Clearly these estimates are not valid for all populations, since growth in late adolescence is largely a function of the individual's environment, but without such simplification comparison of heights in this age group would be impossible. Moreover, the results presented in Table B.1 of the Appendix indicate that these estimates are generally valid.

height selectivity of migrants from country A to country B, and if country C was very similar to country A in terms of development, then we adjusted the migrant height of country C by the same centimeter differential as country A migrants displayed, compared to the stayers of this country. However, this adjustment was necessary for only a small fraction of our sample, specifically, a mere 0.7%, out of the 1.5% of our sample observations based on migrant heights.

We have taken great care to identify all the biases that may have been generated by the institutional context – enlistment in the military, incarceration in prisons, and sale in the slave trade, chiefly – in which heights were recorded.[11] Voluntary soldier samples were included only if satisfactory statistical methods had been used to eliminate the height bias of truncated samples. As for other potential biases, one way to estimate their possible effect is to regress stature on a full set of birth decade and country dummy variables.

As for those institutional contexts that are specific to certain world regions and time periods, we have included them in a series of bias-analysis regressions, each designed to expose a potential bias typical of a given region or time period. For example, we had to rely on prison samples for Latin America and North America in the 19th century (Table 3), whereas for most European countries we could obtain conscript samples, which as a rule entail a broader portion of the social spectrum; and anthropological samples were virtually our sole source for certain world regions.[12]

Self-reported heights are particularly prevalent in industrial countries in the later 20th century. Since, according to a number of studies, male respondents tend to overestimate their own height, we have adopted the corrective recently proposed by Hatton and Bray (2010), and will test its accuracy.

Table 3 Share of sample measurements taken in prison by world region and half century

	1810–1849	1850–1899	1900–1949	1950–1989
East Asia	0	0	0	0
East. Eur./Cntr. Asia	0	0	0	0
Latin America/Car.	0.813	0.375	0.039	0
Mid. East/N. Afr.	n.a.	0	0	0
North America/Au/Nz	0	0.263	0	0
South Asia	0	0	0	0
Southeast Asia	0	0	0	0
Sub-Saharan Africa	0	0	0	0
Western Eur.	0.020	0	0.014	0

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[11] We also did our best to rid our data set of social, ethnic, and regional biases. On migrant height bias, see Baten and Blum 2010.

When it comes to data sources for the study of height trends in the Middle East and Africa, there is a drawback of early anthropological surveys in that the importance of identifying individuals by birth cohort was not yet understood, because it was assumed that the physical measurements of a given population did not evolve from one decade to the next. The result is that, when dependent on anthropological data, we have been obliged to approximate birth decades, and accept the possibility that a small proportion of those individuals identified as belonging to a given cohort in fact belonged in one of the two adjacent ones. Koepke and Baten (2008) and Stegl and Baten (2009) succeeded in estimating average heights in such cases by using a large number of studies that reflect in sum the changes over time. It should be noted though that time trends that result from such estimations resemble moving averages in that they smooth out the evolution of height averages. For example, if there was a height decline among a given population during the 1880s but only 70% of the individuals in the data set upon which we draw in order to analyse this decline belonged to the 1880s cohort (the remaining 30% having been born in the previous one), the decline would appear to be smoother than, in fact, it was.

When we regress human stature on a full set of country and birth-decade dummies and on those potential-bias variables, the coefficients of the latter turn out to be insignificant (Table 4). The coefficients are also small in most cases, with the exception of the slave coefficient. But not only is the negative coefficient for slaves (our slave data being limited to early-19th-century Africa) statistically insignificant; the only comparison group consists of military recruits. Thus it may very well be in this special case of slaves that an insufficient amount of data, for the purposes of comparisons, accounts for the large coefficient. For other anthropometric studies, it is a very important result that prisoners and voluntary soldiers did not differ significantly from other height sources, because this had been an issue in many earlier studies.

In the interest of accuracy we also assessed the possible biases of aggregate age, late-adolescent growth, self-reported heights, and migrants with and without adjustment (Baten and Blum 2010, Appendix Table B.1). We found these potential biases to be insignificant, with the possible exception of positive coefficients for migrants, underlining the need not only to exclude unadjusted heights but also, by means of dummy variables, to control for any and all other potential biases.[13]

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12 The cutoff criterion for including a world region and a half century was 10% with one notable exception: that of “aggregated ages,” for which we had to estimate the birth decade in which the majority of measured individuals were born; in this case we raised the level to 30%.

13 We also created dummy variables for the rare cases that we encountered of significant regional, ethnic, and social selectivity (e.g., workers in South Africa), and include those dummies in our regressions below. By “significant” we mean evidence (derived from more or less contemporary studies) of a one-centimetre (or greater) deviation from the national mean.

Table 4 Potential biases caused by the institutional context of measurement

	(1)	(2)	(3)	(4)
Voluntary soldiers	−0.31			
	(0.28)			
Women		0.31		
		(0.47)		
Prisoners			0.82	
			(0.21)	
Slaves				−2.45
				(0.44)
Time-fixed effects	YES	YES	YES	YES
Country-fixed effects	YES	YES	YES	YES
Constant	166.63***	165.04***	163.03***	162.95***
	(0)	(0)	(0)	(0.000010)
N	91	401	416	67
R-square	0.79	0.83	0.90	0.96

Note: Robust p-values in brackets. *, **, *** refer to significance levels of 1, 5, and 10%. The cutoff criterion for including a world region and half century was usually 10%. Only in the case of "aggregated ages," for which we had to estimate the birth decade in which the majority of measured indivduals were born, we resorted to a 30% criterion. The other constant refers to all other observations in which the potential bias does not appear.

3. ESTIMATES OF HEIGHT TRENDS

Our estimates of world-region trends for the entire 1810–1989 period are based on the population-weighted averages of 156 countries, without interpolations (Figure 1). We used the standard world-region classifications with one exception: we aggregated the group comprising of North America, Australia, and New Zealand, because of certain demographic similarities (chiefly populations featuring European settlers and high cattle-per-capita values). We observe that this group at first had very high values but that toward the end of the 19th century they declined somewhat, converging with some of the other groups, but resuming their upward trend at the start of the next century. The first wave of globalisation, at the end of the 19th century, was not a boom for the populations of New World food-exporting regions. The shift of high-quality foodstuffs from local to export markets may not have been the only factor; immigration into these regions no doubt caused higher population pressure and changes in agricultural practices which in turn led to a decline in protein consumption per capita. Western Europe came close to their level during the 1950s and 1960s, which hence came to be known as its Golden Age.

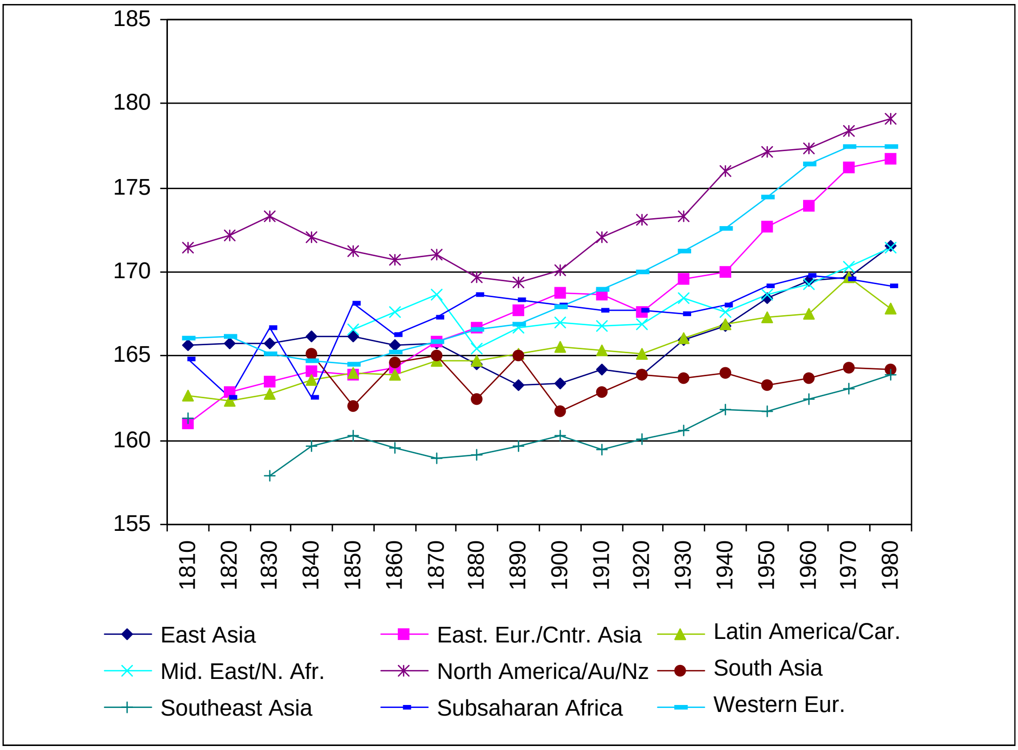

Figure 1: Height development by world region (no interpolations, weighted by population size)
Note: The country-specific estimates and their sources are available at the Tuebingen height data hub and the ClioInfra central data hub: http://www.uni-tuebingen.de/fakultaeten/wirtschafts-und-sozialwissenschaftliche-fakultaet/faecher/wirtschaftswissenschaft/lehrstuehle/volkswirtschaftslehre/wirtschaftsgeschichte/data-hub-height.html and www.clio-infra.eu.

Eastern Europe and the socialist part of central Asia lagged somewhat behind Western Europe, whereas East Asia did quite well during the early 19th century, only to decline to the level of a middle group, composed of Latin America, Sub-Saharan Africa, and the Middle East. African heights were the only ones to decline during the period 1960–89. The shortest heights worldwide were to be found in Southeast and South Asia.

However, the world-region estimates using only recorded measurements may be biased if samples are not random for the region in question: that is, if there were variations in the amount of reliable data available for each country in that region. To compensate for any such missing values, we applied the best possible interpolation strategy: whereever possible, we identified a benchmark level estimate for each country that allows obtaining levels that are close to true height values for the country to be interpolated. We then used the variation over time of other, nearby countries with similar characteristics. Linear interpolation was to be avoided, because of the risk that it might obscure certain fluctuations: for instance, declines that occurred in certain countries during the second half of the 19th century. Instead, we opted for backward- and forward-projection techniques, using the country-specific benchmark years and obtaining the changes between benchmark and estimated decades from a similar and neighboring country. For example, the change from the 1870s to the 1880s in Iraq is more similar to the change in Iran over the same period, than one would conclude from the results of a linear interpolation in Iraq between 1870 and 1890. Keeping the height level with the 1870 Iraq benchmark guarantees its accuracy. (The interpolated values are represented by the white cells in Table 1 (Appendix), with the exception of the Middle East 1810–49 and South Asia 1810–29, for which no reasonable interpolation was possible.) The correlation between world-region trends based exclusively on real-height values and the series that include interpolations is quite close (Figure 2).

We can distinguish several groups of world regions.

1. The Anglo-Saxon settlements had very high anthropometric values for much of the period under study, not converging with lower ones until the late 19th century, and then only moderately.

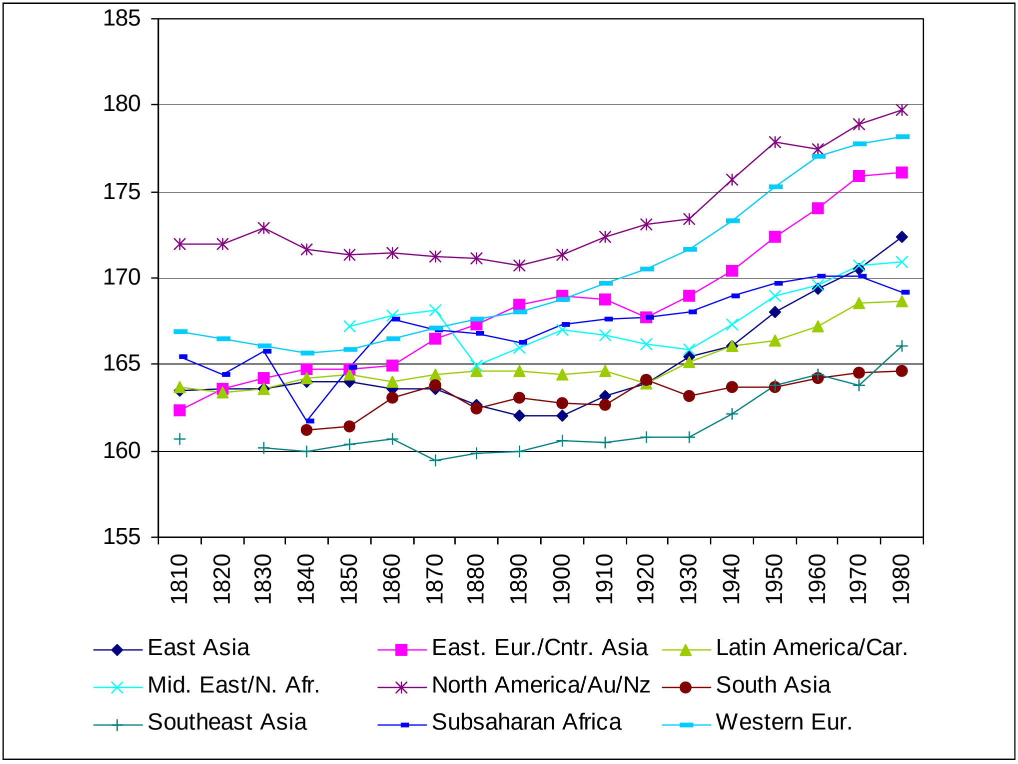

Figure 2: Height development by world region (using interpolations, weighted by population size)
Note: Migrant heights are included; see Table 1 (Appendix).

2. Both Western Europe and those countries in Eastern Europe and central Asia that had ever experienced socialist rule recorded a strong upward trend after the 1880s. However, once the USSR came into being the differential between these two regions increased (Komlos 1999; Mironov 2006; it is the latter's estimates that we apply). In contrast, levels in Latin America, the Middle East, and North Africa were at relatively high levels in the 19th century but during the 20th century experienced only modest increases.
3. East Asia and Sub Saharan Africa remained throughout the entire period near the global average except East Asia during the late 19th century (Figures 1 and 2). Africa is the only world region in which the average height has steadily declined over the last two decades (Moradi 2009).
4. Finally, both South and Southeast Asia remained at a low level throughout the period under study. While no upward trend of any significance occurred in South Asia since the end of the 19th century, Southeast Asia experienced a slight upward trend, but at the start its heights were even lower level than were those of its neighbors (Brennan, McDonald and Shlomowitz 1994; Guntupalli and Baten 2006). In sum, we find that after the 1880s global heights increased on average, but also became more unequal.

4. HEIGHT AND GDP

Height and per-capita GDP are complementary measures of the standard of living. GDP per capita is a measure of a nation's purchasing power or – depending on the interpretation – productivity, whereas height is more closely correlated with nutrition, health care, and inequality. Their interdependence has initially been stressed in the literature (Fogel et al. 1982), but over the past two decades evidence has emerged indicating that they should be regarded as independent indicators. Significant deviations have been found not only between height and GDP but also between height and real wages for unskilled labour (Margo and Steckel 1983). However, these findings are based largely on UK and US data, and the correlation between real wages and heights was actually much closer elsewhere (Baten 2000).

A simple scattergram indicates some positive correlation between real GDP per capita and height (the correlation coefficient is 0.64, the p-value 0.00; Figure 3). Japanese values are exceptional in that they are marked by lower height than expected from GDP. But within Japanese observations there is a positive correlation over time between GDP and height. Deviations on the lower right include three countries of the African Sahel zone (Chad, Burkina Faso, Mali). Deaton (2007) suggests that selective survival of children may account for this deviation, whereas Steckel (2009) argues that the subsistence-level existence of a portion of the population and black-market activity should not be discounted, since they skew national income estimates. Moradi and Baten (2005) argue that local protein consumption was the most likely cause, since poor families unable to sell their protein-rich produce, for lack of a market, end up consuming it themselves. In fact,

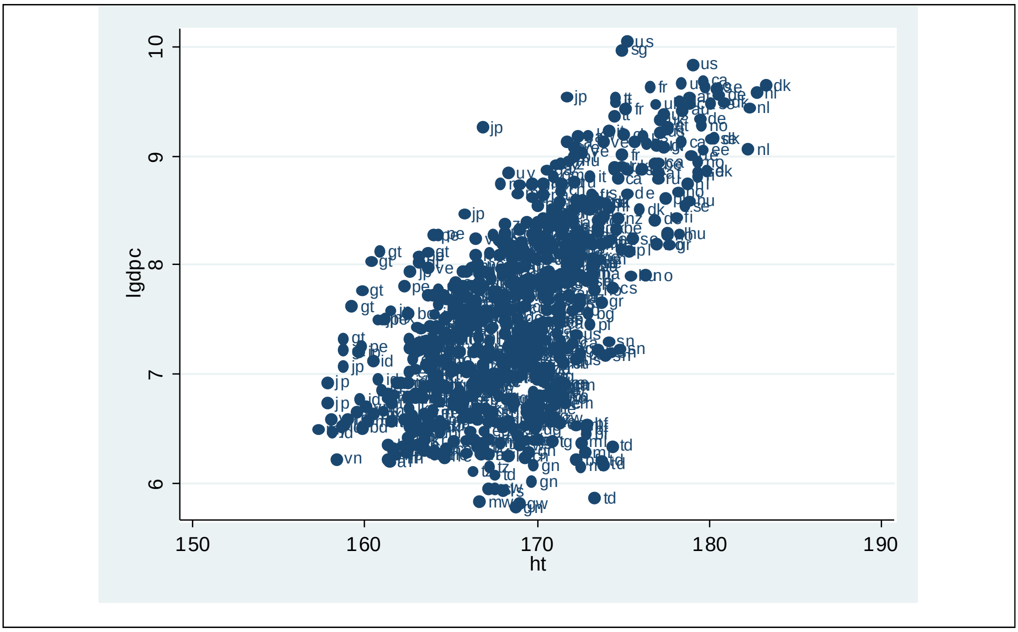

Figure 3: Correlation between (log) income per capita and height
Sources GDP: Maddison (2001)

Chad, Burkina Faso, and Mali are paradigmatic cases of high protein production per capita and low market integration: short on purchasing power, they are nonetheless, thanks to their high-protein diet, relatively tall.

The relatively close overall correspondence between height and GDP – apart from the deviation above which can be explained by local protein consumption patterns – also serves here as a plausibility-check that the new height estimates are reasonable.

One could even estimate per-capita GDP values on the basis of the previously discussed dataset in order to fill gaps in GDP records. However, given the importance of protein and calcium for height development this height-GDP (HGDP henceforth) would be similar to real GDP values in which protein- and calcium-rich foodstuffs would get a very large budget share in the cost of living basket, because heights are very sensitive to the consumption of those goods. Cattle-rich countries such as Mali and Niger would have relatively high values, for example. Moreover, disease events (such as the outbreak of the Spanish Flu during the 1910s, for example, or the Rinderpest of the 1880 and 1890) would cause strong inter-temporal variation which is not typical of GDP values. The strength of HGDP might be more visible in multi-country studies, whereas for individual countries it should probably not be the only source of information. Moreover, given the strong demand for instrumental variables, our data set provided may allow for the application of models in which GDP but not HGDP may be endogenous. It might be possible to develop an adjusted HGDP measure in future research in which HGDP values would be adjusted for cattle availability and disease environment.

We regressed our height estimates on Maddison's (2001) estimates of log GDP per capita first for all birth decades with sufficient observations (Table 5). We note relatively similar coefficients over time, although they increased slightly after 1950. We also used two panels for the periods 1870–1949 and 1950–89. There were two potentially problematic countries, suggesting their exclusion from some of the following calculations: Japan, where the influence of genetic height potentials or intergenerational effects is probably greatest; and Guatemala, because our early height data refer to Indios only. However, whether or not they are excluded has little if any effect (Table 6, Columns 2 and 3). Similarly, fixed-effects estimation and OLS yield similar results. A marginal, one-centimeter, height increase is somewhat more prevalent in the period 1950–89 than in earlier ones; however, it should be noted that the constant has a lower value.

The fixed-effects regression (Table 6, Column 3) prompts us to recommend the following conversion for the period 1870–1949:

$$Ln(GDP) = -10{:}094 + 0{:}105 * Height \qquad (1)$$

For the period after 1950, the formula in Column 4 might be applied; for the period before 1870, formula (1) is our recommendation.

Table 5 Height regressed on log GDP per capita, for individual birth decades

Birth dec.	Coeff.	p-val.	N	R-sq
1870	0.10***	(0.000)	38	0.38
1880	0.11***	(0.000)	20	0.51
1890	0.12***	(0.000)	25	0.44
1900	0.13***	(0.000)	30	0.48
1910	0.14***	(0.000)	38	0.57
1920	0.11***	(0.000)	28	0.56
1930	0.09***	(0.000)	32	0.46
1940	0.10***	(0.000)	31	0.61
1950	0.12***	(0.000)	75	0.33
1960	0.13***	(0.000)	74	0.44
1970	0.15***	(0.000)	78	0.46
1980	0.15***	(0.000)	79	0.52

Robust p-values in brackets. *, **, *** refer to significance levels of 1, 5, and 10%.

Table 6 Regressions of log GDP on height

	(1)	(2)	(3)	(4)
Period	1870-1949	1870-1949	1870-1949	1950-1989
Estimation	OLS	FE	FE	OLS
Countries excl.	JP/GT	JP/GT	None	JP/GT
Height	0.119***	0.102***	0.105***	0.143***
	(0)	(0)	(0)	(0)
Constant	−12.384***	−9.615***	−10.094***	−16.717***
	(0)	(9.20e-10)	(1.84e-10)	(0)
Observations	242	242	251	306
R-squared	0.53	0.46	0.47	0.44

Robust p-values in brackets. *, **, *** refer to significance levels of 1, 5, and 10%.

CONCLUSION

Drawing on anthropometric information from 156 countries spanning the period 1810–1989, we find that regional height levels around the world were fairly uniform throughout most of the 19th century, with two exceptions: above-average levels in Anglo-Saxon settlement regions and below-average levels in Southeast Asia. After 1880, substantial divergences began to differentiate other regions. We find that most of the anthropometric divergence between today's industrial and developing nations took place after this period. While the impressive height level that the region comprising the Middle East and North Africa had enjoyed prior to that point fell back in relative terms, South and Southeast Asia remained from the outset at the back of the pack. Africa performed surprisingly well during the period 1900–65 but has struggled since. In short, after 1880 the world population became taller on average, but more unequal.

We also estimated per-capita GDP values on the basis of the previously discussed dataset in order to fill gaps in GDP records. However, given the importance of protein and calcium for height development this height-GDP (HGDP) measure is similar to real GDP values in which protein- and calcium-rich foodstuffs get a very large budget share in the cost of living basket, because heights are very sensitive to the consumption of those goods.

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APPENDIX

Table A1 World regions, individual countries, and birth decades: coverage of the data set (shading indicates that real data was available and was accepted)

Co	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980
Cn	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hk													■	■				
jp								■	■	■	■	■	■	■	■	■	■	■
kp								■	■	■			■	■	■	■	■	■
kr							■	■	■	■				■	■	■	■	■
mn											■		■					
tw					■	■	■	■	■	■	■	■	■	■	■	■	■	
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am					■	■			■	■	■			■		■	■	■
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ba																		
bg								■					■	■	■			
by				■						■								■
cs					■		■	■	■							■		
cz	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	
ee				■			■		■	■	■					■	■	■
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hr	■	■	■	■	■	■	■	■		■			■		■	■		
hu	■	■	■	■	■	■	■	■							■	■	■	
kg								■	■	■	■	■	■		■	■	■	
kz				■	■		■		■	■	■	■	■		■	■	■	
lt				■										■				
lv				■				■	■	■				■				
md				■											■	■	■	■
mk										■	■	■	■					
pl				■		■	■	■	■	■	■		■	■	■	■		■
ro				■	■	■	■	■		■				■				
ru	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
si							■					■			■		■	
sk					■	■	■	■				■	■	■				
tj						■	■	■	■	■	■							
tm									■		■	■						
ua		■	■	■	■		■	■										
uz									■	■	■	■		■	■	■	■	
ar	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
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br	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
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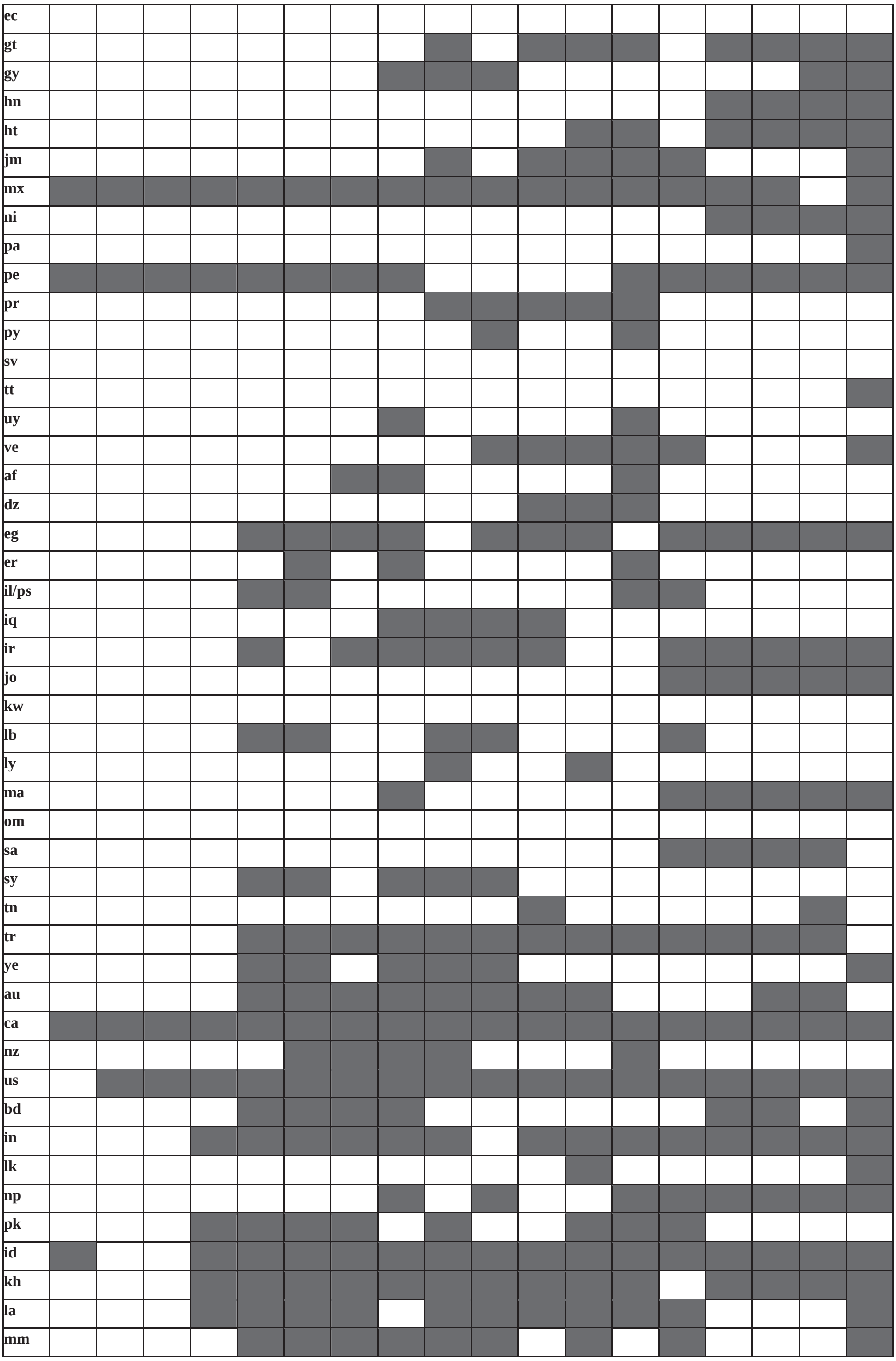

ec																		
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jm									■		■	■	■	■				■
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af							■	■					■					
dz											■	■	■					
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lk												■						■
np								■		■			■	■	■	■	■	■
pk				■	■	■	■		■			■	■	■				
id	■			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
kh				■	■	■	■	■	■	■	■	■	■		■	■	■	■
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tp									▨									
vn			▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨					▨
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gq													▨					
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ke								▨	▨	▨	▨	▨			▨	▨	▨	▨
km															▨	▨	▨	
lr											▨	▨	▨		▨	▨	▨	▨
ls										▨					▨	▨	▨	▨
mg						▨				▨	▨	▨			▨	▨	▨	▨
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be	■	■	■	■	■	■	■			■				■		■		
ch		■	■				■	■	■	■	■	■	■					
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de	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
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fi	■	■	■			■				■	■	■	■	■	■	■	■	■
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ie	■	■	■	■			■	■	■	■		■	■		■	■	■	■
it	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
nl	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
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pt	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
se			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
uk	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Note: Migrant heights (unadjusted), with the number of birth decades in parentheses, in the following countries: Algeria (2), Armenia(1), Bangladesh (4), Croatia (Hrvatska) (1), Czech Republic (1), India (6), Israel (1), Korea (North) (6), Malawi (1), Mozambique (1), Pakistan (1), Poland (2), Romania (1). Sources: see Baten and Blum 2010, Data Appendix