Shrinking in a Growing Economy? The Mystery of Physical Stature during the Industrial Revolution

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The interest generated by the anthropometric research program since the pioneering publications of the late 1970s has been predicated to a considerable degree on the discovery of previously unknown cycles in human physical stature since the Industrial Revolution in both Europe and North America.[1] A diminution in the physical stature of Americans born in the late 1830s was first reported by Robert Margo and Richard Steckel in 1983 on the basis of Union Army records (Figure 1) [2] This discovery, as well as the subsequent finding of a similar trend in life expectancy, called into question the common wisdom that the rapid expansion of the US economy during the antebellum decades brought about an unambiguous and monotonic improvement in the human condition.[3] The biological standard of living was hardly expected to decline at a time when per capita output rose by some 50 percent between 1830 and 1860.[4] After all, food is a normal good whose consumption should not diminish at a time of general economic prosperity.[5]

That Europeans were not exempt from such anthropometric cycles was discovered two years later.[6] The first decrease in physical stature occurred earlier in Europe, coinciding with the onset of the Industrial Revolution (c.1760 to 1800).[7] It is less paradoxical than the subsequent height cycle beginning in the 1830s, inasmuch as real wages fell consistently

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[1] Steckel, "Slave Height Profiles", and "Strategic Ideas."

[2] Margo and Steckel, "Heights." Dates refer to birth cohorts throughout this article, unless otherwise noted.

[3] Pope, "Adult Mortality." For England, see, Huck, "Infant Mortality"; and Szreter and Mooney, "Urbanization." Costa and Steckel assert that "the years after 1830 are often glorified by economic historians as signifying the onset of industrialization and improving living standards, yet our measure of HDI [Human Development Index] indicates that welfare essentially stagnated during the early phase of industrialization because modest increases in per capita income and literacy were offset by declines in stature." "Long-Term Trends," p. 73.

[4] Weiss, "U.S. Labor Force Estimates" p. 27.

[5] Subramanian and Deaton, "Demand."

[6] Komlos, "Stature."

[7] This is not the place to discuss either the timing of the onset of modern economic growth or the conceptualization of the Industrial Revolution. Suffice it to say that both economic and demographic growth were ubiquitous, even if regionally confined, in late eighteenth-century Europe. So was growth in per capita product. I use the concept of modern economic growth in this Kuznetsian sense. Kuznets, *Modern Economic Growth.* It is true, that these countries were at different levels of economic development, but they all participated in the cyclical upswing in business activity of the late eighteenth century, and were part of an international economy They all urbanized, industrialized, and experienced rapid population growth. So it is plausible that the nutritional cycles they experienced were also similar.

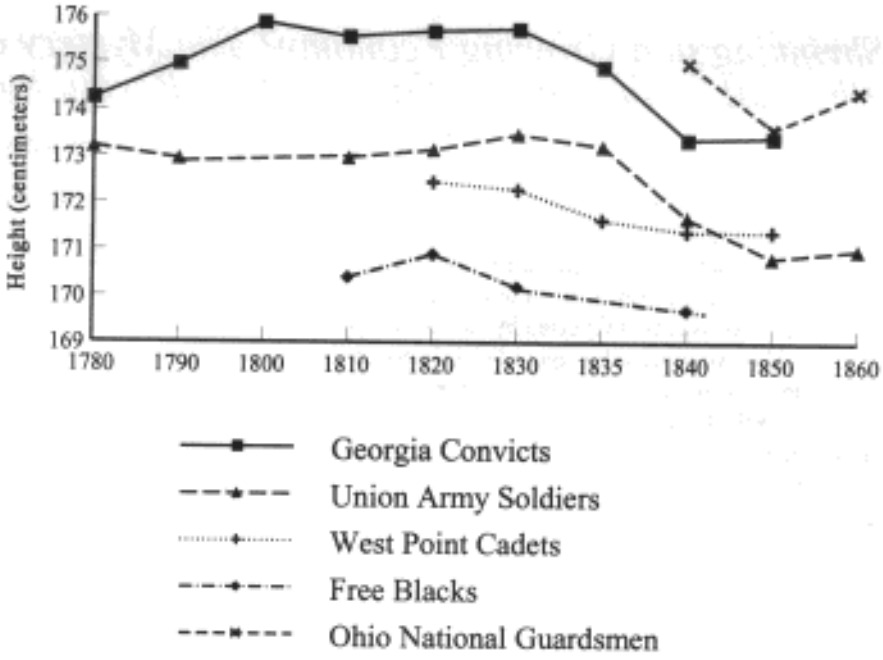

FIGURE 1
HEIGHT OF AMERICANS

Sources: Komlos and Colcanis, "On the Puzzling Cylce"; Costa and Steckel, "Long-Term Trends"; Komlos, "Height and Weight" and "Toward an Anthropometrics History"; and Steckel and Haurin, "Health and Nutrition."

throughout all of Europe for much of that period.[8] The decline was subsequently found to be synchronous in four European countries: the United Kingdom, Sweden, the Habsburg Monarchy, and Bavaria (Figure 2).[9] In each case, the trends were consistently confirmed in several independent samples: in the Habsburg Monarchy among recruits born in five provinces and in the United Kingdom among Irish, Scottish, and English soldiers. The decline

[8] Real wages fell in Britain by about 20 percent between 1750 and 1800, but by 1820 they reached their 1750 level again. Only thereafter were some gains registered. Crafts and Mills, "Trends," pp. 179-80. London bricklayers sew the purchasing power of their wages halved between 1734 and 1802. Schwarz, "Standard," p.39. Feinstein, "Pessimism," finds that real wages in Britain tended to stagnate but not decline during and immediately after the beginning of the Industrial Revolution. However, his index begins in 1770, which was at the trough of the secular trend. He also finds that that was little improvement, if any, in real incomes during the first half of the nineteenth century. The English pattern was also evident on the Continent; in Vienna, for instance, wages could purchase one-third less bread in the 1780s than they could a half century earlier. Sandgruber, *Anfänge,* p. 115. Similarly in Sweden, real wages were just about halved between c. 1735 and 1805 for agricultural workers. Jörberg, *History,* Vol.2, p. 185. In Munich nominal wages divided by rye prices in 1770/75 were only 40 percent of their 1730/35 value. Baten, *Ernährung,* Chapter 4.

[9] Sandberg and Steckel, "Heights"; Komlos, *Nutrition, p.* 58, "Secular Trend," and "Malthusian Trap"; Steckel, "Stature," p. l 920; Mokyr and O'Grada, "Height,"; and Baten, "Einfluss." In contrast, Floud, Wachter, and Gregory argued at first that heights increased in the United Kingdom among those born during the Industrial Revolution. *Height,* p. 151-152. They have recently revised their position and acknowledge that heights did, indeed, decrease at least during the period 1760-1780s. Yet, even according to their own revised estimates the heights of the 1760s were not reached again until half century later, that is, until the birth cohorts of the 1810s. Floud and Harris, "Health," p. 101, 102.

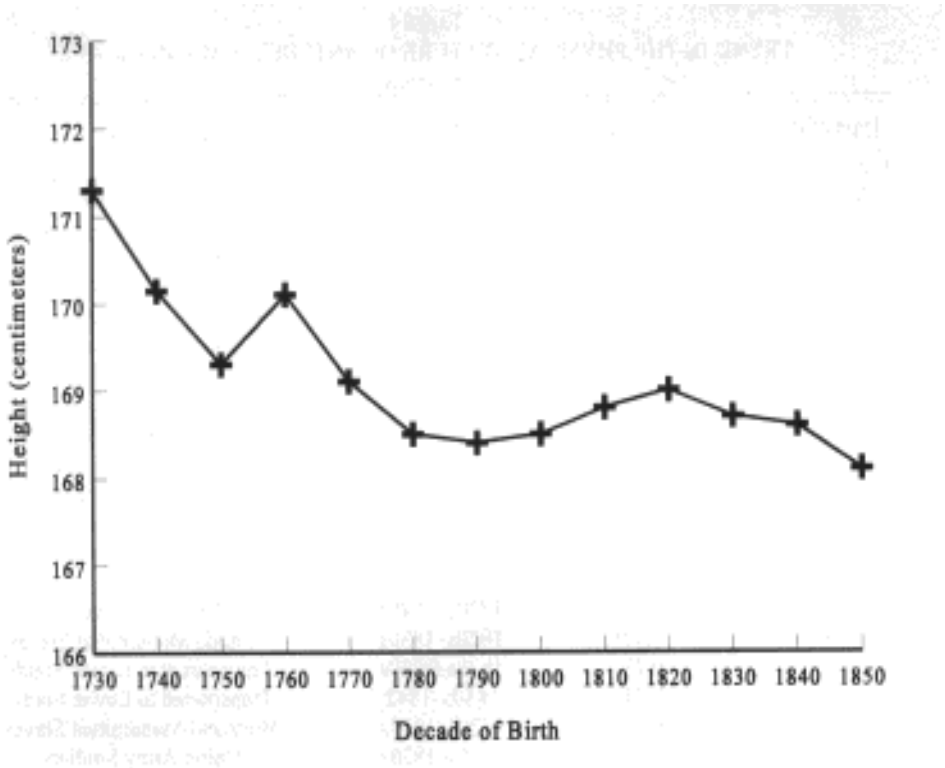

FIGURE 2
HEIGHT OF ENGLISH SOLDERS, 20-23 YEAR OLDS

Source: Komlos, "Secular Trend."

is also evident among civilians, such as children, convicts (both male and female), and indentured servants transported to colonies in the New World.[10] In the United States, too, the pattern was found repeatedly: among West Point cadets, the free blacks of Maryland and Virginia, Georgia convicts, Amherst students, New York and Pennsylvania soldiers, and Ohio National Guardsmen (Table 1).[11] Moreover, the American downswing of the 1830s and 1840s had its European counterpart as well.[12]

[10] Komlos, "Secular Trend"; and Nicholas and Steckel, "Heights." Riley's study of heights in mid-nineteenth-century Britain is an exception: he did not find heights declining. His analysis of the trend is incomplete, however, inasmuch as he did not standardize his results by place of birth or by occupation of his sample. In addition, the social composition of his sample is unclear. See Riley, "Height," p. 478.

[11] Komlos, "Height and Weight"; and "Toward an Anthropometric History"; Komlos and Coclanis, "On the Puzzling Cycle"; Murray, "Standards"; Steckel and Haurin, "Health"; Cuff, "The Anthropometric History"; and Bodenhorn, "Most Wretched Class".

[12] This includes Austria, England, Ireland, Scotland, Bavaria, Netherlands, Sweden, and Russia. Mironov, "New Approach." The trend of heights in France is less clear: heights declined among students of the Ecole Polytechnique but not among army recruits. van Meerten, "Developpement"; Weir, "Parental Consumption Decisions"; Komlos, "Nutritional Status"; and Selig, "Malnutrition." Weir suggests that France's low level of urbanization, slow population growth, and wider distribution of property were the main reasons heights did not decline in the early stages of industrialization. Weir, "Economic Welfare," p. 163. Sandberg and Steckel report that Swedish heights diminished only in the 1840s but not in the 1830s. Sandberg and Steckel, "Was Industrialization Hazardous." In the Netherlands heights began to decline earlier (c. 1810) and reached a trough among the 1840s birth cohorts at a low level (164 cm). Not until the cohorts of 1865 were recruits as tall as those born in 1810. Drukker and Tassenaar, "Paradoxes," p. 341.

TABLE 1
TREND IN THE PHYSICAL STATURE OF ANTEBELLUM AMERICANS
(centimeters)

Type of People	Change[a]	Period	Sample
Free			
White men	-1.30	1830s-1840s	Union Soldiers
	-0.79	1830-1835/40	Union Soldiers from Pennsylvania
	-1.00	1820s-1840	Union Soldiers from New York State
	-0.69	1820s-1835/39	Georgia Convicts
	-1.65	1835/39-1840s	Georgia Convicts
	-0.56	1820/34-1840s	West Point Cadets
	-1.20	1830s-1840s	Amherst Students
	-2.00	1850-1860	Ohio National Guardsmen
Black men	-1.29	1820s-1830s	Virginians Born Free
	-2.21	1820s-1830s	Baltimore Born Free
	-0.56	1820s-1830s	Maryland Born Free
Black women	-1.25	1820s-1830s	Virginians Born Free
	-0.56	1820s-1830s	Maryland Born Free
Slave			
Men	0.00	1830s-1840s	Georgia Convicts
	1.52	1820s-1830s	Virginia Manumitted Slaves
	0.23	1820s-1830s	Transported to Lower South
	2.31	1830s-1842	Transported to Lower South
	0.89[b]	1820s-1830s	Maryland Manumitted Slaves
	0.46[c]	1820s-1830s	Union Army Soldiers
Women	-2.29	1820s-1830s	Virginia Free
	-0.94	1820s—1830s	Maryland Manumitted Slaves

[a] change is for the period indicated.
[b] We do not know how long the persons were slaves before being manumitted.
[c] We do not know who were recently manumitted slaves and who were already free prior to the Civil War.

Sources: A'Hearn, "Antebellum Puzzle"; Bodenhorn, "Most Wretched Class"; Costa and Steckel, "Long-Term Trends"; Craig and Weiss, "Nutritional Status"; Cuff, "Variation"; Haines, "Health"; Komlos, "Height"; Komlos and Coclanis, "On the Puzzling Cycle"; Komlos, "Toward an Anthropometric History"; Margo and Steckel, "Height of American Slaves"; Murray, "Net Nutrition"; and Steckel and Haurin, "Health."

This essay synthesizes the evidence accumulated on the downward phases of these two cycles (c. 1760 to 1800, and 1830 to 1860) on the basis of nearly half a million observations examined since the enigmatic discovery some 15 years ago.[13] Another aim is to argue that these two downswings in physical stature were linked to such economic forces unleashed by the onset of modern economic growth as the rise in income inequality, increase in relative food prices, increased variability of income, urbanization, and industrialization. Although these reinforcing processes, whose impact varied over time and across localities, might have acted in combination with changes in the epidemiological environment, the weight of evidence suggests that the latter does not, by *itself;* satisfactorily resolve the mystery of the "early-industrial-growth puzzle" *(or* in the American context the "antebellum puzzle"). [14]

[13] In contrast to this essay, Steckel's recent overview covers the whole field of anthropometric history. "Stature."

[14] Gallman expressed scepticism about this position in, "Dietary Change." For a rejoinder see Komlos, "Anomalies."

Both the American and European episodes occurred at the threshold of a great socioeconomic transformation and thus afford insights into its welfare effects.[15] Both periods witnessed a shift toward the industrial sector, and both saw a rapid modernization of the institutional framework.[16] The major difference between the two epochs is that, while real wages tended to decline during the second half of the eighteenth century, they tended to rise between 1830 and 1860. Data are obviously more sketchy for the earlier period, and GNP estimates exist only for Great Britain, but it is clear that the (proto)industrial sector was expanding very rapidly throughout western and central Europe. Industrial growth in Great Britain exceeded two percent per annum during the second half of the eighteenth century, and in Bohemia the industrial labor force grew at a rate of 4 percent per annum.[17] During the second period, the national income of all western European countries was growing robustly.[18] Their average was around 1 percent per capita per annum, and real wages tended to increase as well, but at a slower pace.[19] Hence, the decline in physical stature is more of a conundrum during the second cycle under consideration than during the first, insofar as real wages generally declined or stagnated between 1750 and 1800.

ENDOGENOUS EFFECTS

Income Redistribution Effect

In the early phases of modern economic growth income tended to become more unevenly distributed in favor of the upper income brackets.[20] In turn, (ceteris paribus) skewing of the

[15] A similar pattern obtained with the previous great economic transformation, the Neolithic Agricultural Revolution. Coatsworth, "Welfare." For a similar pattern in Japan, see Shay, "Level"; and Hanley, *Everyday Things.* For a rationale for analyzing alternative indexes of well being, see Arrow, "Invaluable Goods"; and Crafts, "Some Dimensions."

[16] Blum, *End;* and Komlos, *Nutrition,* Chapter 3.

[17] Crafts, *British Economic Growth, p.* 26. The Bohemian growth rates are the author's calculations. The pattern was similar in a large number of regions: Flanders, northern France, Krefeld, and Saxony, to mention just a few. See Kisch, *Hausindustriellen;* and Mendels, "Proto-Industrialization".

[18] Rate of Growth of Per Capita Real GDP and Real Wages in Selected European Countries, 1830-1860

Country	GDP	Wages
Belgium	1.8	1.1
U.K	1.6	1.0
U.S.	1.4	0.7
France	1.2	0.4
Netherlands	0.9	0.6
Austria	0.8	n.a.
Sweden	0.8	0.5
Germany	0.7	0.4

Sources: Maddison, *Dynamic Forces,* pp. 206, 236; Belgian wages pertain to miners 1835 - 1860, Scholliers and Zamagni, *Labour 's Reward, p.* 203; Weiss, "U.S. Labor Force Estimates," p. 27; Feinstein, "Pessimism," table 5; Gömmel, *Realeinkommen, p.* 27; U.S. wages pertain to laborers; simple averages were calculated for the four regions given in Goldin and Margo, "Wages," p. 99; LevyLeboyer and Bourguignon, *French Economy, p.* 329; and Smits, Horlings, and van Zanden, "Measurement;" and Jörberg, *History, p.* 350.

[19] In a historical context this was an unprecedented achievement, given the rapid rate of population growth at the time. Bairoch, "Europe's Gross National Product," pp. 279, 288.

[20] Kuznets, *Modern Economic Growth, p.* 212; Williamson and Lindert, *American Inequality,* pp. 62, 67; for United States see also Lindert, "Toward a Comparative History," p. 216; Van Zanden, "Tracing"; Horrell, "Home Demand"; and Williamson, "Did British Capitalism," p. 18; and "British Inequality," p. 61, 62; and *Inequality, Poverty, p.* 15. Williamson's calculations have been criticized

income distribution could have had an adverse impact on average physical stature, inasmuch as the income elasticity of demand for food was less than one and the marginal contribution of nutrients to human growth diminished with increasing food intake.[21] These mutually reinforcing effects meant that a shift in the distribution of income from the lower to the upper stratum caused a decrease in the height of the offspring of the former group, while the height of the children of the upper classes improved by less, and therefore did not compensate the diminution of the former. To be sure, an increase in average income could well have counteracted the deleterious effect of income inequality, provided it was large enough and distributed broadly in the society.

Yet, economic growth was not a Pareto-optimal process because technological change depressed the market value of some skills and capital. Hence, there were people who were made worse off by the onset of industrialisation.[22] That the coefficient of variation of physical stature increased over time in Bavaria and was greater in urban than in rural areas is an indication that not only income but nutritional resources were also becoming more unevenly distributed.[23] Similarly, the range of heights across occupations increased in the United States in the first half of the nineteenth century.[24] Hence, to the extent that the benefits of modern economic growth accrued unevenly, and some were made worse off, the trends of average physical stature and income could have diverged from one another.

Although this effect may not have been important in all regions under consideration, one would expect it to have been strongest among groups who possessed human or physical capital whose supply was inelastic. Handloom weavers were one such group at the lower end of the income distribution, whereas landowners, at the opposite end, benefited from the increasing demand for land. Hence, the physical stature of upper- and middle-class German students improved at the end of the eighteenth century, in vivid contrast to that of the lower classes.[25] A similar pattern obtained in the 1840s among those West Point cadets whose father was a professional, and among Harvard students, whose height did not diminish initially, as did that of the sons of the common man.[26] Likewise, the sons of English gentry were unaffected by the adverse developments of the "hungry" 1840s.[27] The inference is that the skewing of the income distribution, reinforced by some of the other effects listed below,

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in Feinstein, "Rise," p. 704. Lindert suggests that inequality "probably" increased between 1750 and 1815. "Unequal Living Standards," pp. 383, 385. Crafts ("Real Wages," p. 87) concludes that "it would seem probable [that] there were some small increases in inequality in the first half of the nineteenth century but not the substantial change supposed by Williamson". For the Swedish, Belgian, and German confirmation of the Kuznets curve see, Söderberg, "Wage Differentials," p. 79; Scholliers, "Industrial Wage Differentials," p. 116; and Dumke, "Income Inequality," pp. 129, 135. Kaelble and Thomas ("Introduction," p.55), thus reflect the concensus view in stating that in the nineteenth century "pressures operated to widen income dispersion." That per capita gross domestic product rose faster than real wages is indirect evidence that the share of property and capital income increased at midcentury; see note 21. For divergence in regional inequality in the United States see Kim, "Economic Integration." For an increase in the Gini coefficient in Eastern Europe during the recent transition to a market economy, see Milanovic, "Income," p. 133.

[21] First reported in Steckel, "Height." Ceteris paribus refers to holding average incomes constant over the period. See also Steckel, "Stature," p. 1928.

[22] Mokyr, *Lever, p.* 153.

[23] Baten, "Besitzverteilung."

[24] Costa and Steckel, "Long-Term Trends," p. 61.

[25] Komlos, *Nutrition, p.* 87; and "Height." A Dutch middle-class orphanage spent 51 percent of its food budget on milk, butter, and meat, and hence spent 50 percent more on food than one whose inmates consisted of lower-class children. McCants, "Meeting Needs," pp. 203, 206.

[26] Their height did decrease slightly, however, during the Civil War. Bowles, *New Types, p.* 25.

[27] The gentry students were attending the Sandhurst Royal Military Academy. Floud, Wachter, and Gregory, *Height, p.* 175; and Jordan, *Degeneracy Crisis, p. 4.*

favored these social groups. There was an analogous divergence in the life expectancy of the upper and lower income groups during the period under consideration.[28]

Relative Price Effect

Movements in real income by themselves obviously do not determine the trend of food consumption; relative prices also matter. At the onset of modern economic growth, the relative price of nutrients increased, partly because technological change and capital accumulation in agriculture were slower than in industry but also because of diminishing returns to labor in food production, particularly in Europe. In Britain, for instance, the price of food relative to textiles rose by 66 percent between 1770 and 1795.[29]

Consumers rearranged their consumption bundle in response to this increase in relative nutrient prices first by substituting industrial commodities for food products and within the food budget itself by substituting carbohydrates for protein rich foods. This was most noticeable among farmers, workers, and among the lower middle class. Even with a moderate increase in income, and even if a higher utility level was reached, the consumption of food might decline, provided the positive income elasticity of demand for food was not sufficiently large to overcome the negative substitution effect.[30] This does not imply that consumers were hungry despite rising real incomes. They could economize on food expenditures while maintaining the same degree of satiation by substituting inexpensive starchy foods for more expensive meats and dairy products.[31] The European diet became essentially vegetarian; meat consumption retained only a symbolic value for Sundays and holidays.[32]

Extant data on agricultural output are consistent with the above considerations: per capita food output was generally declining in Europe in the late eighteenth century and either stagnating or declining in both Europe and North America in the 1830s and 1840s, in the latter case, despite rising incomes.[33] In the United States per capita food production declined by some 8 percent between 1839 and 1849.[34] With GNP per capita increasing by 11 percent between those two dates, calorie intake would have increased by some 5.5 percent if the income elasticity of demand for food had been on the order of 0.5.[35] However, an

[28] Lindert, "Unequal Living Standards," p. 362.

[29] Clark, Huberman, and Lindert, "British Food Puzzle," p. 233.

[30] A study of the contemporary Third World finds that increases in rice prices have a negative effect on children's height. Senauer and Garcia, "Determinants".

[31] Utility is maximized subject to a weight (or volume) constraint not a nutrient constraint, inasmuch as consumers did not know about nutrient contents of food such as vitamins, minerals, and proteins.

[32] Abel, *Agrarkrisen;* Labrusse, *La crise;* and Bekaert, "Caloric Consumption." In Rome the consumption of meat declined during the course of the eighteenth century from 31 to 23 kg. per capita. Revel, "Capital City's Privileges." Per Capita consumption of meat in early-nineteenth century Europe was well below 20 kg per annum. For Belgium, see Scholliers, " Historical Food Research," p. 81. In Sweden the price of cows relative to grain increased by 27 percent between the 1770s and 1820s and then by another 44 percent until the 1860s. Jörberg, *History, Vol.* 2, p. 323.

[33] "All available direct estimates of foodstuffs supplies per caput show them to be stagnant or even declining slightly in the industrial revolution period." Clark, Huberman and Lindert, "British Food Puzzle," p. 218; Mokyr, "Is There Still Life?"; and Crafts, *British Economic Growth.* For the absence of growth in the consumption of imported items such as tea and sugar see, Mokyr and O'Grada, "Poor."

[34] Gallman, "Commodity Output," pp. 46-48. The level of per capita food production of 1839 was not exceeded until well after the Civil War, even though per capita GNP increased in the 1850s by a further 20 percent. The per capita availability of pork declined at mid century. Cuff, "Weighty Issue." His calculations have been criticized by Gallman, "Pork Production."

[35] An estimate of the British income elasticity of demand for calories at the turn of the nineteenth century is around 0.4, similar to estimates for contemporary India. Clark, Huberman and Lindert, "British Food Puzzle," p. 224; and Subramanian and Deaton, "Demand," p. 161.

increase in relative food prices counterbalanced this tendency. With a price elasticity of demand of -0.5, a 28 percent increase in the relative price of food would have sufficed to bring

about such a result.[36] It is clear that relative food prices increased by at least this amount, even if, because of the wide regional diversity, country-wide averages are unavailable. In Philadelphia, for instance, relative food prices rose by 37 percent between the 1820s and 1850s, but the increase in farm-gate prices was much greater: in Vermont the price of grain relative to cloth increased by some 173 percent during the same time span.[37] In Britain, the price of food did not increase relative to industrial products in the 1830s and 1840s, but the price of meat relative to grain did. Hence, in spite of some increase in real wages in the 1840s and 1850s, the share of expenditure on meat and dairy products decreased by 17 percent, and that on grain increased by some 20 percent, in response to a 40 percent rise in the price of meat relative to grains.[38] In sum, a century after the beginning of the Industrial Revolution, poorer English workers still consumed only miniscule amounts of meat and milk (24 grams and 3.7 ounces per day, respectively).[39] The increase in relative nutrient prices affected a broad segment of the population, but particularly those whose income was not increasing rapidly.[40]

A further consideration is that the nutrients were not distributed evenly within the population. Hence, a seemingly small decline in average food consumption could have had a major impact on people at the lower tail of the income distribution, even in the United

[36] The compensated own-price elasticity of demand for milk was - 1.5 in nineteenth century France. Postel-Vinay and Robin, "Eating." The price elasticity of demand for grain in preindustrial Europe was around -0.7. Persson, "Seven Lean Years," p. 696. An implication of the relative price effect is that nominal wages divided by food prices would have fallen. That, indeed, turns out to be the case forartisans and laborers, but less so for clerks:

Index of Nominal Wages Divided by Grain Prices in Philadelphia

Year	Artisans	Laborers	Clerks
1820s	100.0	100.0	100.0
1830s	86.0	84.8	87.8
1840s	92.7	100.0	126.7
1850s	86.9	89.5	111.4

Source: Bezanson, Gray, and Hussey, *Wholesale Prices;* and Goldin and Margo, "Wages". The unweighted averages of the regional wages reported by Goldin and Margo were used for these calculation. I thank Paul Rhode for suggesting the above calculation.

37 Bezanson, Gray, and Hussey, *Wholesale Prices,* pp.392,394; and Adams, "Prices." In Germany, the price of plant products relative to industrial goods doubled between the 1820s and 1840s, early 1850s. Baten, "Der Einfluss," Chap.5. The increase in relative grain prices was due to a considerable degree to a rise in productivity in textiles and also to the integration of hitherto isolated markets which increased the price of agricultural products discontinuously in many cases.

38 Horrell, "Home Demand." To be sure, trends in real wages are not identical to to those of real income, because the number of hours worked, as well as the labor force participation rate of family members could have changed over time.

39 Meat consumption had not increased since the beginning of the Industrial Revolution. Clark, Huberman, and Lindert, "British Food Puzzle," p. 223.

40 We should, however, also entertain the possibility that the rise in the average per capita income in antebellum America has been overestimated because, for example, of the paucity of evidence on such items as the cost of housing. Research on rents shows that in New York City, "Incorporating the new housing price indices into existing antebellum cost-of-living deflators (which generally exclude housing) suggests that economic historians have over-estimated real wage growth before the Civil War." The overestimate was between 7 and 22 percent. Margo, "Rental Price"; and "Price," pp. i, 18. Even if one city is obviously not representative of the country, this finding is suggestive of the fragility of available cost-of-living indices.

States, where the average was far above European levels.[41] The estimated average daily intake in 1839 of American adult men of 3,882 kilocalories was well above the requirement of 3,300 kilocalories for doing eight hours of heavy work. Nonetheless, 14 percent probably consumed below 2,700 kilocalories, which would not have been adequate for heavy work at a sustained level. Even a small decline in average caloric intake meant that by 1849 this proportion would

have almost doubled.[42] Hence, even a small leftward shift of the distribution of food consumption meant that an increasing proportion of the population was falling below a minimum threshold level, thereby making the attainment of the heights of the 1820s increasingly difficult.[43] This was more the case in Europe where food consumption accounted for a larger share of the total budget than in the United States.[44]

An additional reason why the height of upper-middle-class students did not decline in the 1830s is that the income of their parents increased sufficiently to overcome the increase in the relative nutrient prices.[45] The nutritional status of adult male slaves did not diminish either, at a time when that of the free common people, both white and black, did.[46] This is indirect evidence of the importance of the relative price effect for free consumers because one can infer from this pattern that consumers who were making choices for themselves in the 1830s and 1840s responded to the changes in relative prices, whereas those who were not free were not allowed to do so. Masters had different incentives to feed their human chattel than households had to feed their children.[47] For masters what mattered was the price of food relative to the value of marginal product of slaves (reflected in their prices) and not relative to industrial goods. The increase of slave prices relative to the price of food, by 64 percent, provided an incentive for the slave owners not only to maintain, but even to increase, the nutritional status of their slaves (Figure 3).

[41] European average daily adult food intake was about 1,000 kcal below American levels. Clark, Huberman and Lindert, "British Food Puzzle," p. 223; and Bekaert, "Caloric Consumption". Of course, nutrition ought not be measured just in calories and proteins but ought to include vitamins and minerals as well. Even middle-class diets were deficient in calcium, vitamins Bl, B2, and niacin. McCants, "Monotonous," p. 85.

[42] The same argument applies to protein intake. Komlos, "Anomalies."

[43] Gallman reports a decline of some 5 percent in labor productivity in the agricultural sector between 1839 and 1849. His estimate of annual per capita meat production in the United States show a decrease of some 11 percent during the 1 840s (in 1879 dollars). Gallman, "Commodity Output", pp. 31, 48.

[44] The fact that West Point cadets were actually quite slender suggests that even in the resource-abundant United States people were not consuming nutrients in great excess relative to their needs. The average weight of a 17-year-old, 67 inches tall cadet was circa 126 lb, as compared to the 140 lb standard today. Today's standard of the body-mass index of 17-year olds is 21.9. In contrast, West Point Cadets' and Citadel students' index values were 19.0 and 19.4, the latter as late as the 1890s. Cuff, "Body Mass Index"; Coclanis and Komlos, "Nutrition," p. 104; and Frisancho, *Anthropometric Standards, p.* 168.

[45] The wages of clerks increased in the United States much more than that of laborers and artisans. Goldin and Margo, "Wages," pp. 98-100.

[46] This pattern has been confirmed on two different samples: Georgia convicts and slaves shipped in interregional trade. Steckel, "Health of American Slaves"; and Komlos and Coclanis, "On the Puzzling Cycle." The heights of black soldiers in the Union army did decline, possibly because those were made up of ex-slaves and free blacks. Hence, the trend in their nutritional status depended on the share of each group in the sample. Margo and Steckel, "Height of American Slaves." Note that Steckel's initial analysis in "Slave Height Profiles," p. 377, has been superseded by his "Health of American Slaves."

[47] This does not mean that slaves were treated better than free children. Slaves received less fresh milk than free children at the beginning of the period. While free households decreased the amount of milk allotted to home consumption in the antebellum decades, slave owners may not have.

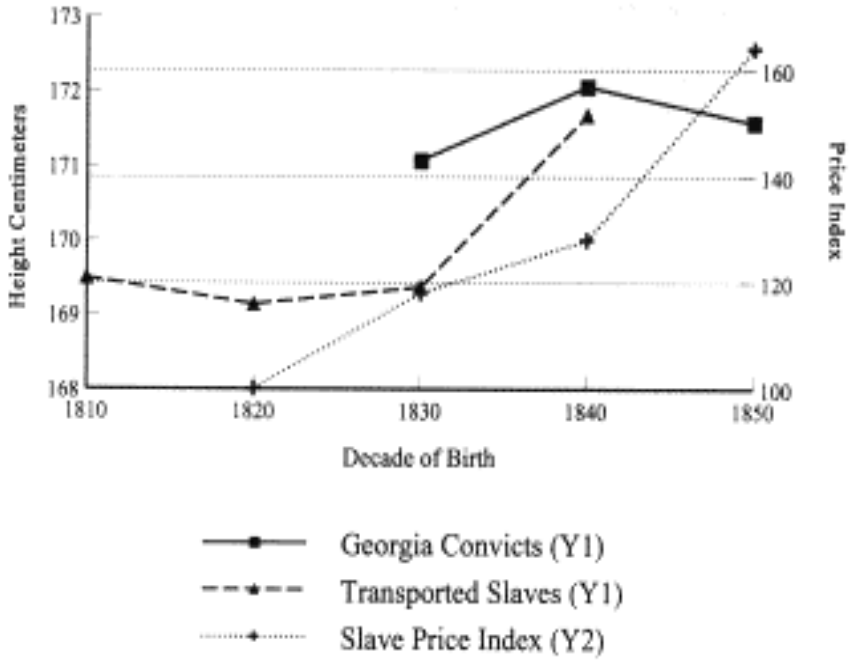

FIGURE 3
HEIGHT AND PRICES OF ADULT MALE SLAVES

Sources: Ransom and Sutch, "Capitalists"; Komlos and Coclanis, "On the Puzzling Cycle"; and Steckel, "Health of Americans."

Income Variability Effect

With the onset of industrialization, money income became more variable for the substantial segment of society that had severed its ties to the land, especially as the incidence of cyclical unemployment increased with industrialization. Even if the reduction in food consumption brought about by such adverse developments was temporary, its stunting effect on children could be permanent. A downturn of the business cycle of several years' duration may have been too long to enable them to "catch up" to their natural growth profile once the income of the family had reached its long-run trend again.[48] Hence, the decline in heights of the second half of the 1830s may very well have been caused, or at least exacerbated, by the recession of 1837.[49]

In the United States, the contractions of 1837/43 and 1848/55 brought about unemployment with a potential impact on food budgets: in the South Atlantic region, real wages declined in the 1830s across a broad range of occupations. There is independent corroborating evidence of a rise in poverty in some areas of the country. With the onset of industrialization more people became detached from the land, and spells of unemployment became more of a threat thereby than earlier.[50] Hence, another probable reason why the height

[48] Steckel has argued for the importance of the "catch up" effect among slave children, but they failed to catch up fully to the height of their white neighbors. Steckel, "Stature."

[49] The recession of the 1890s may have had similar repercussions not only in the United States but in Australia as well. Steckel and Haurin, "Health"; Coclanis and Komlos, "Nutrition"; and Whitwell, de Souza and Nicholas, "Height."

[50] Komlos, "Anomalies," p.212; and Woitek, "Height Cycles."

of middle-class children born in the 1830s did not decline is that the income of their parents was subject to less variation than those of the common man.

Population Growth Effect

Population growth contributed to the deterioration in nutritional status, because of diminishing returns to labor in the agricultural sector, particularly in Europe, where the opportunities for expansion of arable land were quite limited.[51] The increase in bread prices throughout Europe at the end of the eighteenth century was a direct outgrowth of population expansion.[52] As a consequence, caloric intake declined almost universally.[53] Thus, both episodes of declining nutritional status took place at a time of rapid demographic expansion. Population growth in Europe around 1800 reached one percent per annum, which in a historical perspective was very rapid indeed. The population of the antebellum United States grew at an even faster pace: 3.0 percent per annum.

Industrialization Effect

The sectoral shifts brought about by the onset of modern economic growth meant that a typical peasant or farmer produced food for a larger number of industrial households, at a time when the mechanization of agriculture had not yet begun.[54] Moreover, the world supply of food remained price inelastic until the opening of the American West. In short, during the early stages of modern economic growth, given the state of technology, populations experienced a downward pressure on their nutritional status.

Furthermore, industrialization and its concomitant, the increased division of labor, in turn unleashed other processes, including the integration of hitherto isolated regions into a larger world market, that magnified their impact on nutritional status. Transportation improvements had a similar impact on market integration.[55] Previously, remoteness from markets tended to have a propitious effect on nutritional status because much of the output of family farms was consumed within the household.[56] No exceptions have been found to this generalization: it holds true for Maryland as well as for Japan and accounts for the height advantage of the Irish and Scotch over the English.[57] Yet, once able to sell their products easily, subsistence farmers, lacking full knowledge of the technology of health production,

[51] Insofar as population growth leads to diminishing returns to labor in agriculture, it can also lead to an increase in the relative price of food. Nonetheless, one should not conflate the two effects, because population growth does not have to lead to a rise in food prices. That depends on such factors as the nature of technological change and the elasticity of the world's food supply. Note that in the twentieth century the relative price of food declined, in spite of rapid population growth. Hence, it is useful to distinguish among the independent effects of population growth, industrialization, and urbanization on height.

[52] Abel, *Agrarkrisen.*

[53] This was the case, for example, even in the Amsterdam municipal orphanage. McCants, "Monotonous," p. 85.

[54] To be sure, British agricultural productivity was relatively advanced, but even it did not keep pace with population growth. Clark, Huberman, and Lindert, "British Food Puzzle," p. 233.

[55] Specialization in meat packing in the Midwest meant that an increasing share of the meat consumed was transported over longer distances. That brought with it at least a 16 percent loss in protein availability because the inferior parts of the animals were not shipped in long-distance trade. Holmes, "Meat Situation," pp. 116-24. On the preparation of blood pudding through bleeding, see Gibson and Smout, *Prices, p.* 239.

[56] "Once again the rise of a market for local produce seems to have led to a deterioration in the variety and content of diet." Gibson and Smout, *Prices,* pp. 229-230.

[57] Riggs, "Standard"; and Shay, "Level."

traded away proteins, minerals, and vitamins essential to the health and nutrition of their children. Although such producers gained from the transaction in monetary terms, their children became stunted (and less healthy) as a consequence.

For the previously self-sufficient household, the impact of market integration was practically identical to the relative price effect, except that, once integrated into a larger market, the prices of its products increased discontinuously, from the local shadow price to a higher urban price.[58] Consequently, price indices based on recorded urban prices are downwardly biased, inasmuch as they do not reflect the larger increases in farm-gate prices. Given the size of the self-sufficient sector at the time, the extent of the bias is likely to be substantial. Hence, the substitution away from food consumption in the wake of market integration was probably much greater than that implied by changes in urban prices. The impact of this effect would have been greatest in regions that were newly integrated into the world market, such as Tennessee and Kentucky in the antebellum period.[59]

Industrialization also fostered urbanization insofar as locating near other producers generated positive externalities. Town dwellers, however, were generally at a disadvantage for procuring nutrients because they were farther from the source of food supply, and, unlike the rural population, were not paying farm-gate prices for agricultural products. Town dwellers paid for the costs of transporting food and for the services of middlemen. Until the invention of refrigerated railroad cars and ships, transportation technology was not sufficiently advanced to accommodate the shipment of milk and fresh meat over long distances in sufficient quantities and at low enough prices to affect the diet of urban workers. The wedge between rural and urban prices of such perishables must have played a significant role in the urban rural height differences, inasmuch as dairy products provide crucial nutrients for optimal physical (and mental) development.[60] Moreover, fruit and vegetables were consumed primarily in season, for canning did not become economical until the 1870s.[61]

Both episodes of deterioration in the biological standard of living were accompanied by an unprecedented rise in the urban population. During the second half of the eighteenth century town dwellers in northwestern Europe increased by 57 percent.[62] The urban population of the United States grew between 1800 and 1860 at a rate of 5 percent per annum, while the growth of the agricultural labor force, at around 2.5 percent per annum, was much slower. Moreover, advances in agricultural productivity did not suffice to maintain the output of nutrients at pre-industrial levels.[63] Hence, the number of persons without ties to the land and dependent on the farm population for sustenance increased, and an ever larger segment of the society was being separated from the source of food supply. The amount of nutrients released by the farm population did not suffice to maintain the nutritional status of the urban population, because the latter was growing too rapidly. Thus, several studies have found a positive correlation between per capita swine and milk production and physical stature at the local level.[64] In sum, the processes of urbanization, commercialization, industrialization,

[58] The market-integration effect is not identical to the relative-price effect, because market integration may not affect the long-run urban price of food. It may mean only that goods are shipped from a wider radius into the city, leaving the city price unchanged.

[59] Komlos, *Nutrition, p.* 58.

[60] Bogin,"Patterns,"p. 132.

[61] Mokyr, *Lever, p.* 140; and "Technological Selection."

[62] De Vries, *European Urbanization, p.* 30. In 1750 no European city even came close to having a million inhabitants, whereas in 1850 Paris and London combined had a population of 3.6 million.

[63] In the 1 840s total factor productivity even declined. Craig and Weiss, "Hours at Work," Table 3.

[64] The closer was one to the source of nutrients, the lower were food prices, and the higher was nutritional status. Komlos, "Anomalies"; Haines, "Health"; Craig and Weiss, "Nutritional Status"; and Baten, "Der Einfluss." For the importance of milk in the Scottish diet see, Gibson and Smout, *Prices, Food, p.* 227. Higher milk and sugar prices, particularly in urban areas, have a negative impact on child

market integration, and regional specialization, which all accompanied the onset of modern economic growth, put downward pressure on the nutritional status of the populations of the then developing world.

Intensification of Labor Effect

With the onset of industrialization more children worked in factories than previously and may have expanded more energy there than their preindustrial counterparts, thereby impinging on their nutritional status.[65] This is a matter of some controversy, but even if that were the case, the increased work effort led not only to an increased expenditure of energy but also to increased income to the benefit of children during their growing years.[66] Moreover, insofar as not only children, but also the adults of the household worked more intensively than before, their incremental income would have been capable of purchasing additional calories for their children, thereby more than compensating for the energy requirements of factory work. Thus, household income, and hence nutritional status, was higher than it would have been without industrialization.[67]

In any event, this effect could not have been very powerful because the steepest decline in height in the late eighteenth century generally occurred not in urban-industrial regions but in more backward agricultural ones. Furthermore, the increase in heights in the 1 820s and their subsequent decline are difficult to reconcile with a hypothetical increase in work effort. On the contrary, one would expect that heights would have increased in Britain in the 1830s in response to the Factory Laws of 1832 which limited the extent of child labor and reduced the number of hours worked. Furthermore, child labor in factories was a small percentage of the total, and was actually decreasing over time independent of government intervention.[68] Hence, trends in work effort do not explain very well the anthropometric cycles.

Exogenous Effects

Besides these six endogenous processes, several exogenous ones may also have exerted downward pressure on nutritional status.[69]

Weather Effect

At the end of the eighteenth century, weather conditions deteriorated in Europe. Winter temperatures in Switzerland, for instance, were some 0.7 degrees Celsius colder during the second half of the century than in the 1 730s. Similarly in England the mean annual temper

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height in contemporary Brazil: a two-standard-deviation increase in the price of milk decreases the average height of five-year-old boys by two centimeters. Thomas and Strauss, "Prices."

[65] Voth, "Physical Exertion" and "Height."

[66] The number of days worked on farms is estimated to have remained constant during the period under consideration. See Clark and Van der Werf, "Industrious Revolution." Voth, in contrast, suggests that the number of hours worked annually by adults annually increased during the second half of the eighteenth century. Voth, "Time". Agricultural workers in the United States increased their labor input between 1840 and 1860 from32.8 to 34.8 hours. Craig and Weiss, "Hours at Work," Table 2. Insofar as these results pertain to adults, the issue of intensification of child labor, and its effect on adult height, remains open.

[67] Komlos and Ritschl, "Holy Days." On child health production within the family see, Weir, "Parental Consumption Decisions."

[68] Galbi, "Child Labor."

[69] The Civil War as a possible cause of the "antebellum puzzle" has recently been raised in Gallman, "Dietary Change." Yet, insofar as the decline in nutritional status began before the onset of the conflict, the war itself could not have been its only cause.

atures of the 1780s were 0.7 degrees lower than in the 1730s.[70] In the 1 830s and 1 840s, too, temperatures tended to be colder than average, both in Europe and in North America.[71] This

development had an adverse independent impact on agricultural productivity and therefore on nutritional status.[72]

Epidemiological Environment Effect

Although the incidence of diseases and epidemics has an exogenous component, increases in population density also fostered the transmission of diseases. Potentially, the increased trade associated with improved transportation, market integration, urbanization, and industrialization did so as well. Insofar as disease exposure impinged on the body's ability to metabolize nutrients, the more frequent were sicknesses, the greater were the claims on the body's intake of nutrients, and the lower was the nutritional status of the population. Hence, several studies have found a negative correlation between the crude death rate (or the infant mortality rate) and adult stature.[73]

Some scholars have argued that the height cycles were caused primarily by a deterioration of the disease environment.[74] However, if that had been the case, one would expect that all segments of society would have been affected. Diseases would hardly have discriminated by social status to such an extent. Hence, the fact that the physical stature of several groups, including German, British, and American high-status students and male slaves did not decrease at the outset of modem economic growth implies that an increased incidence of disease does not, by itself, explain the "early-industrial-growth puzzle."[75] After all, many of the upper- and middle-class youth were of urban origin and were exposed, in the main, to the epidemiological environment of the common man.[76] To be sure, slaves lived primarily in rural areas but so did southern farmers, whose height did decline substantially.[77]

To be sure, it is possible that a deterioration of the epidemiological environment would have affected the lower income groups, whereas among the wealthier segments of society this effect might have been offset by a sufficient rise in income. Hence, the height of the upper and middle classes could have remained unaffected by the increased incidence of epidemics in spite of the increased claims of the environment on their food intake. Yet, there is no evidence at all that the incidence of diseases increased generally during the period under consideration, and a case has been made that it actually declined. [78]

Moreover, heights increased in both Europe and North America among the birth cohorts of the 1820s, even as population density, urbanization, and commercialization, three important correlates of the ease with which diseases spread, also increased.[79] If the disease environment had been deteriorating monotonically with the increase in population density, physical stature would not be expected to deteriorate first, then improve, before deteriorating once again. The implication is, therefore, that the decline in heights could not have been caused exclusively by a deterioration of the disease environment.

[70] Pfister, *Klimageschichte;* and Manley, "Central England Temperatures."
[71] Catchpole, "Hudson's Bay Company," p. 33.
[72] Baten, *Ernährung,* chap. 4
[73] Weir, "Parental Consumption Decision."

[74] Voth and Leunig, "Did Smallpox Reduce Height?" However, Baten and Heintel show that these inferences are based on incorrect statistical procedures. "Smallpox."

[75] Bowles, *New Types, p.* 25; Floud, Wachter, and Gregory, *Height, p.* 175.

[76] Steckel, "Health and Mortality."

[77]Komlos and Coclanis, "On the Puzzling Cycle."

[78] Schellekens, "Irish Famines"; and Riley, "Insects." In fact, infant mortality declined in some places. Sundin, "Child Mortality."

[79] Floud and Harris, ``Health, Height, and Welfare," p. 101, 102.

In addition, the discovery of 8-year height cycles similar to classical business cycles implies not only that the biological growth process was significantly influenced by short-term fluctuations in economic activity, but, by implication, also that variations in the disease

environment by themselves do not suffice to explain height variations.[80] Hence, the diminution in heights was more likely to have been caused by the economic concomitants of modern economic growth than by an increased exposure to diseases alone.

CONCLUSION

In spite of two decades of research, there remain large gaps in our knowledge of the history of the biological standard of living, and vast amounts of evidence remains unexplored. A recent fascinating study of the effect of economic development on Australian aborigines is just one example of ingenious use of anthropometric evidence. [81] More regional studies would be useful, particularly if such studies could benefit from economic or demographic information available only at the local level.[82] Such analysis could disentangle the effects of disease and economic effects on physical stature. For instance, migration into a frontier area (such as Illinois) which preceded its integration into a larger market would reveal the effect of migration on a local epidemiological environment. Similarly, the coming of canals or railroads into a county might reveal their pure economic impact on heights, provided they were not used extensively for personal transport. More studies of female heights are urgently needed for a more balanced view of the history of human height.[83] Similarly, the available evidence on the upper and middle classes is insufficient. Passport applications, could expand our knowledge in this regard.

Of course, many countries and epochs have not been studied at all. A study of French heights in the eighteenth century might very well yield insights into important changes in economic conditions in France prior to the revolution. The French data are particularly important in that they extend back into the seventeenth century and are therefore the earliest such records known to be extant. Studies of societies for which reliable economic data do not exist, such as the Soviet Union or China, might yield the best estimates of welfare of populations living through forced industrialization in such authoritarian regimes.[84] More studies on the twentieth century would enable us to disentangle the effects of improvements in public health, medical technology, and nutritional status on the human organism. Additional work on birth weights and on bio-mass indices would enable us to explore more fully the relationship between demographic and biological variables. In short, the possibilities for the advancement of the field seem practically limitless.

Nonetheless, much has been achieved, and this article presents evidence on the cyclical nature of the biological standard of living, particularly of the common man in both Europe and North America, at the onset of the profound socioeconomic transformation associated with modern economic growth. Two episodes have been identified during which physical stature was declining: in Europe of the second half of the eighteenth century and in both Europe and North America in the 1830s and 1840s. In contrast to other scholars, who either take an eclectic view of the causes of the height cycles or tend to stress the disease-based explanation, I have argued that these cycles were associated primarily, even if perhaps not

[80] Woitek, "Height Cycles."

[81] Nicholas and Kimberley, "Welfare."

[82] Haines, "Health"; Craig and Weiss, ``Nutritional Status"; and Cuff, ``variation."

[83] Even though evidence on females is rare, anthropometric historians were the first to raise the issue of female living standards as distinct from that of males. Baten and Murray, "Bastardy"; Johnson and Nicholas, "Male and Female Living Standards," p. 479; and Nicholas, and Oxley, `'Living Standards."

[84] Mironov, ``New Approach"; and Morgan, "Biological Indicators."

exclusively, with economic processes and associated structural changes.[85] These included the rapid growth of population and of urbanization, the greater inequality in the distribution of income, the increase in the variability of income, including a rise in the frequency of unemployment, and the integration of segmented markets. Moreover, growth of productivity in agriculture lagged behind, and consequently the relative price of nutrients tended to increase at a time when the transportation revolution was still in its infancy and methods of food

preservation were primitive. This meant, most importantly, that less protein-rich milk and meat reached the children of the increasingly urbanized working-class households. Interaction effects, in which such exogenous factors as the deterioration in weather conditions, also had a role to play, have not been ruled out.

Interpreting this "early-industrial-growth puzzle," or in the American context the "antebellum puzzle," is facilitated by the discovery that some socioeconomic groups were exempt from these anthropometric cycles. This included high-status groups such as European aristocrats and middle-class students whose income was less variable, and either large enough, or rising fast enough, to keep the increase in the relative price of nutrients from influencing their food consumption bundle substantially. Also isolated from the effects of structural change, ironically, were among the most unfortunate of Americans: male slaves, whose value increased to such an extent that their owners had, on efficiency-wage considerations, sufficient incentive to even increase their food allotments.[86] These exceptions to the general downward trend in physical stature provide powerful evidence that the decline in heights was not brought about by a deterioration in the epidemiological environment alone because that would have affected, at least to some extent, middle- and upper-class youth as well as the common man, and slaves as well as free people. In contrast, we argue that the socio-economic changes associated with the onset of modern economic growth were sufficient by themselves to bring about the decline in physical stature.[87] Albeit, we have not ruled out the possibility that an increased incidence of disease exposure in some areas, or among some social groups might have contributed to the decrease in nutritional status.

Thus, the "early-industrial growth puzzle" turns out to be not such a puzzle after all. There is no real theoretical contradiction in the divergence of the secular trend in real income and that of physical stature in the early industrial period. It took a long time, indeed, and several technological breakthroughs for these societies to return to their previous nutritional levels.[88] The decline in the cost of long-distance ocean shipping brought the productivity of the American prairies within the reach of European consumers. The invention of refrigeration enabled perishable agricultural products to be shipped over longer distances. Improvements in public health and sanitation associated with running water and sewer systems, too, made a contribution, as did improvements in medicine.[89] A decline in the fertility rate also made it easier to fend offhunger.[90] Moreover, the increased productivity of the agricultural sector brought about by mechanization meant that by the twentieth century biological well-being in all societies in the Western Hemisphere was increasing monotonically.

In my view, the "early-industrial-growth puzzle" implies that, at the beginning of modem economic growth, progress was not uniform in all dimensions of human existence. It seldom

[85]Riley, for instance, stresses a disease-based explanation in "Height," whereas Costa and Steckel take an eclectic view in "Long-Term Trends," pp. 65-67.

[86] Rees, Komlos, Woitek, and Long, "The Puzzle of Slave Heights."

[87] However, at this stage of the research program we are unable to determine the relative importance of the various factors in bringing about a decline in the biological standard of living.

[88] In South Carolina physical stature did not begin to increase until the twentieth century. Coclanis and Komlos, "Nutrition."

[89]Thomas and Strauss, "Prices."

[90] Weir, "Parental Consumption Decisions," p. 270.

is. In some regards the common men and women of the early industrial age were not as well off as their parents. There was some divergence between their living standard, as conventionally conceived, and their biological well-being. The human organism did not always thrive as well in its newly created socioeconomic environment as one might be led to believe on the basis of purchasing power at the aggregate level.[91]"The absolute gain in income achieved by modern economic growth in the early industrial period. . . "was simply too low to offset declines in health."[92] Childhood nourishment had health implications over the course of a

lifetime. Many years later, as antebellum Americans aged, they suffered more from rheumatism, hernias, hemorrhoids, and respiratory problems than prior generations.[93] Thus, anthropometric history affords a more nuanced view of the welfare of the populations living through the rapid structural changes accompanying the onset of modern economic growth.

[91] A ten centimeter increase in height (from 150 to 160 centimeter) reduced relative mortality risk by 30 percent in Norway between 1963 and 1979 and another ten centimeter increase reduced it by a further 10 percent. Waaler, ``Height, Weight and Mortality," p.16.

[92] Costa and Steckel, "Long-Term Trends," p.70.
[93] Ibid. p.60.

REFERENCES

Abel, Wilhelm. *Agrarkrisen und Agrarkonjunktur: Eine Geschichte der Land- und Ernährungswirtschaft Mitteleuropas seit dem hohen Mittelalter.* First ed. 1935; Hamburg and Berlin: Paul Parey, 1966.

Adams, T. M. "Prices Paid by Farmers for Goods and Services and Received by Them for Farm Products, 1790-1871." University of Vermont and State Agricultural College, Vermont Agricultural Experiment Station, Feb., 1939.

A'Hearn, Brian. "The Antebellum Puzzle Revisited: A New Look at the Stature of Union Army Recruits during the Civil War." In *The Biological Standard of Living in Comparative Perspective,* edited by John Komlos and Jörg Baten, Vol. I. Stuttgart: Franz Steiner, 1998.

Arrow, Kenneth. "Invaluable Goods." *Journal of Economic Literature* 35, no. 2 (1997): 757-65.

Bairoch, Paul. "Europe's Gross National Product: 1800-1975." *Journal of European Economic History* 5, no. 2 (1976): 273 - 340.

Baten, Jörg. "Der Einfluss von regionalen Wirtschaftstrukturen auf den biologischen Lebensstandard." *Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte* 83, no. 4 (1996): 180-213.

_____ "Besitzverteilung und biologischer Lebensstandard im Bayern des frühen 19. Jahrhunderts." In *Wirtschaftsstruktur und Ernährungslage 1750-1850,* edited by Jörg Baten and Markus A. Denzel, 94-107. St Katharinen: Scripta Mercatura, 1997.

_____. *Ernährung und wirtschaftliche Entwicklung in Bayern, 1790-1880.* Stuttgart: Franz Steiner, 1998.

Baten, Jörg, and Markus Heintel. "Smallpox and Nutritional Status in England, 1770-1873: On the Difficulties of Estimating Historical Heights." *Economic History Review* 51, no. 2 (1998).

Baten, Jörg, and John Murray. "Bastardy in Southern Germany Revisited: An Anthropometric Synthesis." *Journal of Interdisciplinary History* 28, no. I (1997): 47-56.

Bekaert, Geert. "Caloric Consumption in Industrializing Belgium." this JOURNAL 51, no. 3 (1991): 633-55.

Bezanson, Anne, Robert D. Gray, and Miriam Hussey. *Wholesale Prices in Philadelphia 1780-1861.* Philadelphia: University of Pennsylvania Press, *1936.*

Blum, Jerome. *The End of the Old Order in Rural Europe.* Princeton: Princeton University Press, *1978.*

Bodenhorn, Howard. "A Most Wretched Class: Heights, Health and Nutrition of Free Blacks in Antebellum Virginia." Unpublished Manuscript, *1997.*

Bogin, Barry. *Patterns of Human Growth.* Cambridge: Cambridge University Press, *1994;* lst publ. *1988.*

Bowles, Gordon T. *New Types of Old Americans at Harvard and at Eastern Women's Colleges.* Cambridge, MA: Harvard University Press, *1932.*

Catchpole, A. J. W. "Hudson's Bay Company Ships' Log-Books as Sources of Sea Ice Data, *1751 - 1870."* In *Climate Since A.D. 1500,* edited by Raymond S. Bradley and Philip D. Jones, 17 - *39.* London: Routledge, *1992.*

Clark, Gregory, Michael Huberman, and Peter Lindert. "A British Food Puzzle, *1770-1850."EconomicHistoryReview48,* no. *2 (1995): 215-37.*

Clark, Gregory, and Ysbrand Van der Werf. "The Industrious Revolution or the Bourgeois Middle Ages?." Unpublished Manuscript, *1996.*

Coatsworth, John H. "Welfare." *American Historical Review* 101, no. 1 (1996*): 1 - 12.*

Coclanis, Peter, and John Komlos. "Nutrition and Economic Development in Post-Reconstruction South Carolina: an Anthropometric Approach." *Social Science History 19,* no. 1 (1995*): 92-115.*

Costa, Dora L., and Richard H. Steckel. "Long-Term Trends in Health, Welfare, and Economic Growth in the United States." In *Health and Welfare during Industrialization,* edited by Richard H. Steckel and Roderick Floud, *47-91.* Chicago: The University of Chicago Press, *1997.*

Crafts, N.F.R. *British Economic Growth during the Industrial Revolution.* Oxford: Clarendon Press, *1985.*

_____. "Real Wages, Inequality and Economic Growth in Britain, 1750-1850: A Review of Recent Research." In *Real Wages in l 9th and 20th Century Europe. Historical and Comparative Perspectives,* edited by Peter Scholliers. Oxford: Berg Publishers, *1989.*

_____. "Some Dimensions of the Quality of Life' during the British Industrial Revolution." *Economic History Review 50,* no. *4 (1997): 617 - 39.*

Crafts, N.F.R., and Terence C. Mills. "Trends in Real Wages in Britain, 1750-1913." *Explorations in Economic History 31,* no. *2 (1994): 176-94.*

Craig, Lee, and Thomas Weiss. "Nutritional Status and Agricultural Surpluses in the Antebellum United States." In *The Biological Standard of Living in Comparative Perspective,* edited by John Komlos and Jörg Baten, Vol. I. Stuttgart: Franz Steiner, *1998.*

Craig, Lee, and Thomas Weiss. "Hours at Work and Total Factor Productivity Growth in the l9th Century U.S. Agriculture, Unpublished Manuscript, Department of Economics, North Carolina State University.

Cuff, Timothy. "A Weighty Issue Revisited: New Evidence on Commericial Swine Weights and Pork Production in Mid-Nineteenth Century America." *Agricultural History 66* no. *4 (1992): 55-74.*

_____ " "The Body Mass Index Values of Mid-Nineteenth-Century West Point Cadets: A Theoretical Application of Waaler's Curves to a Historical Population." *Historical Methods 26,* no. *4* (Fall *1993): 171-82.*

_____. "Variation and Trends in Stature of Pennsylvanians, 1820-1860." In *The Biological Standard of Living in Comparative Perspective,* edited by John Komlos and Jörg Baten, Vol. I. Stuttgart: Franz Steiner, *1998.*

De Vries, Jan. *European Urbanization, 1500-1800.* Cambridge: Harvard University Press, 1984.

Drukker, Jan W., and Vincent Tassenaar. "Paradoxes of Modernization and Material WellBeing in the Netherlands during the Nineteenth Century." In *Health and Welfare during Industrialization,* edited by Richard H. Steckel and Roderick Floud, 331-78. Chicago: The University of Chicago Press, 1997.

Dumke, Rolf. "Income Inequality and Industrialization in Germany, 1850-1913: the Kuznets Hypothesis Re-examined." In *Income Distribution in Historical Perspective,* edited by Y. S. Brenner, Hartmut Kaelble, and Mark Thomas, 117 - 148. Cambridge: Cambridge University Press, 1991.

Feinstein, Charles. "The Rise and Fall of the Williamson Curve." this JOURNAL 48, no. 3 (1988): 699-729.

_____. "Pessimism Perpetuated: Real Wages and the Standard of Living in Britain during and after the Industrial Revolution." *this Journal* 58, no. 3 (1998): 625-60.

Floud, Roderick, Kenneth Wachter, and Annabel Gregory. *Height, Health and History. Nutritional Status in the United Kingdom, 1750-1980.* Cambridge: Cambridge University Press, 1990.

Floud, Roderick, and Bernard Harris. "Health, Height, and Welfare: Britain, 1700-1980." In *Health and Welfare during Industrialization,* edited by Richard H. Steckel and Roderick Floud, 91-126. Chicago: The University of Chicago Press, 1997.

Frisancho, A. Roberto. *Anthropometric Standards for the Assessment of Growth and Nutritional Status.* Ann Arbor, MI: The University of Michigan Press, 1990.

Galbi, Douglas. "Child Labor and the Division of Labor in the Early English Cotton Mills." *Journal of Population Economics* 10, no. 4 (1997): 357 - 75.

Gallman, Robert. "Commodity Output, 1839 - 1899." In *National Bureau of Economic Research, Studies in Income and Wealth, Vol. 24: Trends in the American Economy in the Nineteenth Century,* 13-71. Chicago: The University of Chicago Press, 1960.

_____. "Changes in Total U.S. Agricultural Factor Productivity in the Nineteenth *Century." Agricultural History* 46, no. 1 (1972): 191 - 210.

_____. "American Economic Growth before the Civil War: The Testimony of the Capital Stock Estimates." In *American Economic Growth and Standards of Living before the Civil War,* edited by Robert Gallman and John Wallis, 79-115. Chicago: The University of Chicago Press, 1992.

_____. "Pork Production and Nutrition During the Late Nineteenth Century: A Weighty Issue Visited Yet Again." *Agricultural History* 69, no. 4 (1995): 592-606.

_____. "Dietary Change in Antebellum America." this JOURNAL, 56, no. 1 (1996): 193-201.

Gibson, Alex J. S. and T. C. Smout. *Prices, Food and Wages in Scotland 1550-1780.* Cambridge: Cambridge University Press, 1995.

Goldin, Claudia, and Robert Margo. "Wages, Prices, and Labor Markets before the Civil War." In *Strategic Factors in Nineteenth Century American Economic History. A Volume to Honor Robert W. Fogel,* edited by Claudia Goldin and Hugh Rockoff, 67 - 104. Chicago: The University of Chicago Press, 1992.

Gömmel, Rainer. *Realeinkommen in Deutschland. Ein internationaler Vergleich (1810.1914)* Nürnberg: Klett-Cotta, 1979.

Haines, Michael. "Health, Height, Nutrition, and Mortality: Evidence on the 'Antebellum Puzzle' from Union Army Recruits for the New York State and the United States." In *The Biological Standard of Living in Comparative Perspective,* edited by John Komlos and Jörg Baten, Vol. I. Stuttgart: Franz Steiner, 1998.

Hanley, Susan. *Everyday Things in Premodern Japan: the Hidden Legacy of Material Culture.* Berkeley: University of California Press, 1997.

Holmes, George. "Meat Situation in the United States." U.S. *Department of Agriculture Report* no. 109 *(July 1916).*

Horrell, Sara. "Home Demand and British Industrialization." this JOURNAL *56,* no. *3 (1996): 561-604.*

Huck, Paul. "Infant Mortality and Living Standards of English Workers during the Industrial Revolution." THIS JOURNAL *55*, no. *3 (1995): 531-47.*

Johnson, Paul, and Stephen Nicholas. "Male and Female Living Standards in England and Wales, *1812 - 1857:* Evidence from Criminal Height Records." *Economic History Review48*, no. *3 (1995): 470-81.*

Kaelble, Hartmut and Mark Thomas. "Introduction." In *Income Distribution in Historical Perspective,* edited by Y. S. Brenner, Hartmut Kaelble, and Mark Thomas, *1-56.* Cambridge: Cambridge University Press, 1991.

Jörberg, Lennart. *A History of Prices in Sweden, 1732-1914. 2* vols. Lund: CWK Gleerup, *1972.*

Jordan, Thomas. *The Degeneracy Crisis and Victorian Youth.* Albany: State University of New York Press, *1993.*

Kim, Sukkoo. "Economic Integration and Convergence: U.S. Regions, 1840-1987." National Bureau of Economic Research, Working Paper no. *6335* (Dec. 1997).

Kisch, Herbert. *Die Hausindustriellen Textilgewerbe am Niederrhein vor der Industriellen Revolution: von der Ursprünglichen zur kapitalistischen Akkumulation.* Göttingen: Vandenhoeck and Ruprect, 1981.

Komlos, John. "Stature and Nutrition in the Habsburg Monarchy: the Standard of Living and Economic Development in the Eighteenth Century." *American Historical Review* 90, no. *5 (1985):* 1149-61.

_____. "The Height and Weight of West Point Cadets: Dietary Change in Antebellum America." this JOURNAL 47, no. 4 *(1987): 897-927.*

_____. *Nutrition and Economic Development in the Eighteenth Century Habsburg Monarchy: An Anthropometric History.* Princeton: Princeton University Press, *1989.*

_____. "Height and Social Status in Eighteenth Century Germany." *Journal of Interdisciplinary History 20,* no. 4 *(1990): 607 - 21.*

_____. "Toward an Anthropometric History of African-Americans: The Case of the Free Blacks in Antebellum Maryland." In *Strategic Factors in Nineteenth Century American Economic History. A Volume to Honor Robert W. Fogel,* edited by Claudia Goldin and Hugh Rockoff, *297 - 331.* Chicago: The University of Chicago Press, *1992.*

_____. "The Secular Trend in the Biological Standard of Living in the United Kingdom." *Economic History Review 46,* no. 1 (1993*): 115-44.*

_____. "A Malthusian Episode Revisited: the Height of British and Irish Servants in Colonial America." *Economic History Review 46,* no. *4 (1993): 768-82.*

_____. "The Nutritional Status of French Students." *Journal of Interdisciplinary History 24* no. *3 (1994): 493-508.*

_____. "Anomalies in Economic History: Reflections on the Antebellum Puzzle." this JOURNAL *56,* no. 1 (1996*): 202 - 14.*

Komlos, John, and Peter Coclanis. "On the Puzzling Cycle in the Biological Standard of Living: the Case of the Antebellum Georgia." *Explorations in Economic History 34* no. *4 (1997): 433-59.*

Komlos, John, and Albrecht Ritschl. "Holy Days, Work Days, and the Standard of Living in the Habsburg Monarchy." *Journal of Interdisciplinary History 26,* no. 1 (1995*): 57-66.*

Kuznets, Simon. *Modern Economic Growth: Rate, Structure, and Spread.* New Haven: Yale University Press, 1966.

Labrusse, C. *E. La crise de l 'economie francaise a la f n de l 'Ancien Regime et au debut de la Revolution.* Paris: Presse Universitaire de France, 1944.

Levy-Leboyer, Maurice, and Francois Bourguignon, *The French Economy in the Nineteenth Century. An Essay in Econometric Analysis.* Cambridge: Cambridge University Press, 1990.

Lindert, Peter. "Toward a Comparative History of Income and Wealth Inequality." In *Income Distribution in Historical Perspective*, edited by Y. S. Brenner, Hartmut Kaelble, and Mark Thomas, 212-31. Cambridge: Cambridge University Press, 1991.
_____."Unequal Living Standards." In *The Economic History of Britain since 1700*, edited by Roderick Floud and Donald McCloskey, Vol. 1 357-86. Cambridge: Cambridge University Press, 1994.

Maddison, Angus. *Dynamic Forces in Capitalist Development. A Long-Run Comparative View.* Oxford: Oxford University Press, 1991.

Margo, Robert. "The Rental Price of Housing in New York City, 1830-1860." THIS JOURNAL 56, no. 3 (1996): 605 - 25.
_____. "The Price of Housing in New York City, 1830-1860." National Bureau of Economic Research, Working Paper Series on Historical Factors in Long Run Growth, No. 63, 1994.
Margo, Robert, and Richard H. Steckel. "The Height of American Slaves: New Evidence on Slave Nutrition and Health." *Social Science History* 6, no. 4 (1982): 516-38.
_____. "Heights of Native Born Northern Whites during the Antebellum Period." this JOURNAL 43, no. 1 (1983): 167 - 74.

Manley, Gordon. "Central England Temperatures: Monthly Means 1659 to 1973." *Quarterly Journal of the Royal Meteorological Society* 100 (1974): 389-405.

McCants, Anne. "Monotonous but not Meager: The Diet of Burgher Orphans in Early Modern Amsterdam." *Research in Economic History* 14 (1992): 69 - 116.
_____. "Meeting Needs and Suppressing Desires: Consumer Choice Models and Historical *Data." Journal of Interdisciplinary History* 26, no. 2 (1995): 191 - 20.

Mendels, Franklin, "Proto-Industrialization: the First Phase of the Industrialization Process," *this Journal* 32, no. 2 (1972): 241-261.

Milanovic, Branko. "Income, Inequality and Poverty during the Transition: A Survey of the Evidence." *MOCT-MOST Economic Policy in Transitional Economies* 6, no. 1 (1996): 131-147.

Mironov, Boris. "New Approach to Old Problems: Well-Being of Russian Population in 1840-1980 on the Basis of Height Data." Slavic Review, forthcoming.

Mokyr, Joel. *The Lever of Riches: Technological Creativity and Economic Progress.* Oxford: Oxford University Press, 1990.
_____. "Is There Still Life in the Pessimist Case? Consumption during the Industrial Revolution, 1790 - 1850." this JOURNAL 48, no. 1 (1988): 69 - 92.
_____. "Technological Selection, Information, and Changing Household Behavior, 1850-1914. Unpublished Manuscript, 1997.
Mokyr, Joel, and Cormac O'Grada. "Poor and Getting Poorer? Living Standards in Ireland before the Famine." *Economic History Review* 41, no. 2 (1988): 209-35.
_____. "Height and Health in the United Kingdom 1815-1850: Evidence from the East India Company Army." *Explorations in Economic History* 33, no. 2 (1996): 141-68.

Morgan, Stephen. "Biological Indicators of change in the Standard of Living in China during the 20th Century." In *The Biological Standard of Living in Comparative*

Perspective, edited by John Komlos and Jörg Baten, Vol. I. Stuttgart: Franz Steiner, *1998.*

Murray, John. "Standards of the Present for People of the Past: Height, Weight, and Mortality among Men of Amherst College, *1834-1949."* this JOURNAL *57 (1997): 585-606.*

Nicholas, Stephen, and Sue Kimberley. "The Welfare of Indigenous and White Australians 1890-1955." In *The Biological Standard of Living in Comparative Perspective,* edited by John Komlos and Jörg Baten, Vol. 1. Stuttgart: Franz Steiner, 1998.
Nicholas, Stephen, and Deborah Oxley, "The Living Standards of Women during the Industrial Revolution, *1795-1820."EconomicHistoryReview, 46,* no. *4 (1993): 723-49.*

Nicholas, Stephen, and Richard H. Steckel. "Heights and Living Standards of English Workers during the Early Years of Industrialization, 1770-1815." THIS JOURNAL 51, no. *4 (1991): 937-57.*

Persson, Karl Gunnar. "The Seven Lean Years, Elasticity Traps, and Intervention in Grain Markets in Pre—Industrial Europe." *Economic History Review 49,* no. *4 (1996): 692-714.*

Pfister, Christian. *Klimageschichte der Schweiz 1525-1860: Das Klima der Schweiz von 1525-1860 und seine Bedeutung in der Geschichte von Bevölkerung und Landwirtschaft. 3rd. ed.* Bern: Paul Haupt, *1988.*

Pope, Clayne. *"Adult* Mortality in America before 1900." In *Strategic Factors in Nineteenth Century American Economic History. A Volume to Honor Robert W Fogel,* edited *by* Claudia Goldin and Hugh Rockoff, *267-96.* Chicago: The University of Chicago Press, *1992.*

Postel-Vinay, Gilles, and Jean-Marc Robin. "Eating, Working and Saving in an Unstable World: Consumers in Nineteenth-Century France." *Economic History Review 45 (1992): 494-512.*

Ransom, Roger, and Richard Sutch. "Capitalists without Capital: The Burden of Slavery and the Impact of Emancipation." *Agricultural History 62,* no. 1 (1988*): 133-60.*

Rees, Ray, John Komlos, Ngo v. Long, and Ulrich Woitek, "The Puzzle of Slave Heights in Antebellum America." Unpublished Manuscript, Department of Economics, University of Munich, *1998.*

Revel, Jacques. "A Capital City's Privileges: Food Supply in Early-Modern Rome." In *Food and Drink in History,* edited by Robert Forster and Orst Ranum, *37-49.* Baltimore: The Johns Hopkins University Press, *1979.*

Riggs, Paul. "The Standard of Living in Scotland, 1800-1850." In *Stature, Living Standards, and Economic Development,* edited by John Komlos, *60-75.* Chicago: The University of Chicago Press, *1994.*

Riley, James C. "Insects and the European Mortality Decline." *American Historical Review 91,* no. *3 (1986): 833-58.*

_____. "Height, Nutrition, and Mortality Risk Reconsidered." *Journal of Interdisciplinary History 24,* no. *3 (1994): 465 - 92.*

Sandgruber, Roman. *Die Anfänge der Konsumgesellschaft.* Vienna: Verlag für Geschichte und Politik, *1982.*

Sandberg, Lars, and Richard H. Steckel. "Heights and Economic History: The Swedish Case." *Annals of Human Biology 14,* no. *2 (1987):* 101 - 10.

_____. "Was Industrialization Hazardous to Your Health? Not in Sweden." In *Health and Welfare during Industrialization,* edited by Richard H. Steckel and Roderick Floud, 127-160. Chicago: The University of Chicago Press, *1997.*

Schellekens, Jona. "Irish Famines and English Mortality in the Eighteenth Century." *Journal of Interdisciplinary History* 27, no. 1 (1996): 29-42.

Scholliers, Peter. "Historical Food Research in Belgium: Development, Problems and Results in the l9th and 20th Centuries." In *European Food History. A Research Review* edited by Hans J. Teuteberg, 71-89. Leicester: Leicester University Press, 1992.

_____. "Industrial Wage Differentials in Nineteenth-Century Belgium." In *Income Distribution in Historical Perspective,* edited by Y. S. Brenner, Hartmut Kaelble, and Mark Thomas, 96-116. Cambridge: Cambridge University Press, 1991.

Scholliers, Peter, and Vera Zamagni. *Labour 's Reward. Real Wages and Economic Change in l 9th- and 20th-century Europe.* Aldershot: Edgar Elgar, 1995.

Schwarz, L. D. "The Standard of Living in the Long Run: London, 1700-1860." *Economic History Review* 38, no. 1 (1985): 24 - 1.

Selig, Jean Michel, *Malnutrition & developpement economique dans l 'Alsace du XlXe siecle.* Strasburg: Presses Universitaires de Strasbourg, 1996.

Senauer, Benjamin, and Mario Garcia. "Determinants of the Nutrition and Health Status of Preschool Children: An Analysis with Longitudinal Data." *Economic Development and Cultural Change,* 39, no. 2 (1991): 371-89.

Shay, Ted. "The Level of Living in Japan, 1885-1938: New Evidence." In *Stature, Living Standards, and Economic Development,* edited by John Komlos, 173-204. Chicago: The University of Chicago Press, 1994.

Smits, J.P. E. Horlings, and J.L. van Zanden. "The Measurement of Gross National Product and its Components. The Netherlands, 1800-1913." Unpublished Manuscript, University of Utrecht, 1997.

Södeberg, Johan. "Wage Differentials in Sweden, 1725-1950." In *Income Distribution in Historical Perspective,* edited by Y. S. Brenner, Hartmut Kaelble, and Mark Thomas, 76-95. Cambridge: Cambridge University Press, 1991.

Steckel, Richard. "Slave Height Profiles from Coastwise Manifests." *Explorations in Economic History* 16, no. 4 (1979): 363 - 80.

_____. "Height and Per Capita Income." *Historical Methods* 16, no. I (1983): 1-7.

_____. "The Health and Mortality of Women and Children, 1850-1860." *Journal of Economic History* 48, no. 2 (1988): 333-45.

_____. "Stature and the Standard of Living." *Journal of Economic Literature* 33, no. 4 (1995): 1903-10

_____. "The Health of American Slaves: New Evidence and Analysis." Unpublished Manuscript, 1995.

_____. "Strategic Ideas in the Rise of the New Anthropometric History and Their Implications for Interdisciplinary Research." this JOURNAL 58, no. 2 (1998).

Steckel, Richard, and Donald R. Haurin. "Health and Nutrition in the American Midwest: Evidence from the Height of Ohio National Guardsmen, 1850-1910." In *Stature, Living Standards, and Economic Development,* edited by John Komlos, 117 - 28. Chicago: The University of Chicago Press, 1994.

Subramanian, Shankar, and Angus Deaton. "The Demand for Food and Calories." *Journal of Political Economy* 104, no. I (1996): 133-62.

Sundin, Jan. "Child Mortality and Causes of Death in a Swedish City." *Historical Methods* 29, no. 3 (1996): 93-106.

Szreter, Simon and Graham Mooney. "Urbanization, Mortality, and the Standard of Living Debate: New Estimates of the Expectation of Life at Birth in Nineteenth Century British Cities." *Economic History Review* 51, no. I (1998): 84-112.

Thomas, Duncan, and John Strauss. "Prices, Infrastructure, Household Characteristics and Child Height." *Journal of Development Economics* 39, no. 2 (1992): 301 - 31.

van Meerten, Michel Alexander. "Developpement Economique et Stature en France, XIXe—XXe Siecles." *Annales ESC* (May-June 1990): 755-77.

Van Zanden, J. L. "Tracing the Beginning of the Kuznets Curve: Western Europe during the Early Modern Period." *Economic History Review* 48, no. 4 (1995): 643-64.

Voth, Hans-Joachim. "Height, Nutrition, and Labor: Recasting the "Austrian Model." *Journal of Interdisciplinary History* 25, no. 4 (1995): 627 - 36.

_____. "Physical Exertion and Stature in the Habsburg Monarchy, 1730-1800." *Journal of InterdisciplinaryHistory27,* no. 2 (1996): 263-75.

_____. "Time and Work in Eighteenth-Century London." this JOURNAL 51, no. 2 (1998): 29-58.

Voth, Hans-Joachim, and Timothy Leunig. "Did Smallpox Reduce Height? Stature and the Standard of Living in London, 1770-1873." *Economic History Review* 49, no. 3 (1996): 541-60.

Waaler, Hans Th. "Height, Weight and Mortality. The Norwegian Experience." *Acta Medica Scandinavica* Supplement 679, 1984.

Weir, David. "Parental Consumption Decisions and Child Health During the Early French Fertility Decline, 1790 - 1914." this JOURNAL 53, no. 2 (1993): 259 - 74.

_____. "Economic Welfare and Physical Well-Being in France, 1750-1990." In *Health and Welfare during Industrialization*, edited by Richard H. Steckel and Roderick Floud, 161-200. Chicago: The University of Chicago Press, 1997.

Weiss, Thomas. "U.S. Labor Force Estimates and Economic Growth, 1800-1860." In *American Economic Growth and Standards of Living before the Civil War*, edited by Robert Gallman and John Wallis, 119-75. Chicago: The University of Chicago Press, 1992.

Whitwell, Greg, Christine de Souza and Stephen Nicholas. "Height, Health, and Economic Growth in Australia, 1860-1940." In *Health and Welfare during Industrialization*, edited by Richard H. Steckel and Roderick Floud, 379-422. Chicago: The University of Chicago Press, 1997.

Williamson, Jeffrey. *Did British Capitalism Breed Inequality?*. London: Allen & Unwin, 1985.

_____. *Inequality, Poverty, and History. The Kuznets Memorial Lectures of the Economic Growth Center, Yale University*. Oxford: Basil Blackwell, 1991.

_____. "British Inequality during the Industrial Revolution: Accounting for the Kuznets Curve." In *Income Distribution in Historical Perspective*, edited by Y. S. Brenner, Hartmut Kaelble, and Mark Thomas, 57 - 75. Cambridge. Cambridge University Press, 1991.

Williamson, Jeffrey, and Peter Lindert. *American Inequality: A Macroeconomic History*, New York: Academic Press, 1980.

Woitek, Ulrich. "Height Cycles in the 18th and l9th Centuries." Unpublished Manuscript, Department of Economics, University of Glasgow, 1998.