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Economics, Human Biology and Inequality: a review of "puzzles" and recent contributions from a Deatonian perspective

Abstract

The Nobel laureate Angus Deaton concentrated his work on puzzling developments and phenomena in economics. Puzzles are exciting elements in economics, because readers feel challenged by the question of how they can be solved. Among the puzzles analyzed by Deaton are: (1) Mortality increase of white, U.S. non-Hispanic men (2000 to today); (2) Why are height and income sometimes closely correlated, but not always?; (3) Height inequality among males and females; and (4) The Indian puzzle of declining consumption of calories during overall expenditure growth.

This article reviews these "puzzles" and the main insights that Deaton derived from their discussion insofar as they pertain to the biological aspects of human development. I will focus on the field of this journal, Economics and Human Biology, in which Deaton has been very active over the last two decades. I will also document some of the responses by other scholars and their contributions to these puzzles, as they relate to the field of economics and human biology.

"Puzzles" as heuristic tools in development and health economics[1]

The Nobel laureate Angus Deaton concentrated his work primarily on puzzling developments and phenomena in economics. Puzzles are exciting elements in economics, because readers feel challenged by the question of how they can be solved. For example, the fact that mortality among middle-aged U.S. whites (aged 45-55) increased since the year 2000 is such a puzzle. Why should mortality increase in a period when average income did not decline substantially (and had reached a historically unprecedented level)? To give a second example, the fact that calorie consumption declined in India in spite of growing income over the last three decades is another puzzle with which Deaton was concerned. This decline in calorie consumption took place in a situation in which the anthropometric record of human height reveals that heavy malnutrition of large parts of the population was still present in India.

In this review article, I will summarize some of Deaton's "puzzles" and the main results that Deaton derived from their discussion. I will focus on the field of this journal, Economics and Human Biology, in which Deaton has been very active over the last two decades. I will also document some of the responses by other scholars and their contributions to these puzzles, as they relate to the field of economics and human biology. Even if these related studies are inspiring by themselves, we will see that not all open questions resolved yet. This provides additional opportunities for future research – and to solve exciting puzzles.

Apart from the mortality increase of white U.S. men and the puzzle of declining consumption of calories during overall growth in India, two other puzzles analyzed by Deaton are why height and income are sometimes closely correlated, but not always, and why height inequality and expenditure inequality in India are correlated among females, but not among males. What might these four "puzzles" have in common? Three aspects come to mind. [2] One

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[1] I thank Inas Kelly, John Komlos, Nicholas Meinzer and Franco Peracchi for important comments.

[2] Special thanks to Franco Peracchi for comments on the following issue.

aspect is the lack of a simple relationship between income and health. Although in general richer individuals spend more on medical goods and healthy nutrition, sometimes public goods also help the poor. In addition, not all consumers are perfectly informed. Some do not value health, but other utility components (status, for example) higher. Another aspect that these "puzzles" might have in common is the role of heterogeneity: did, for example, inequalities play a role that are sometimes hidden in averages? How was the intra-household distribution between genders? Finally, a third aspect is the difficulty of measuring living standards or welfare using a single indicator. Deaton argued that by comparing various indicators − among them anthropometric ones − we can gain better insights into the real trends of welfare; but we also face some puzzles (Deaton 2016, page 12-25).

Puzzle 1: Mortality increases among non-Hispanic white men in the U.S. (2000 – today)

Case and Deaton (2015) intensively studied the mortality of middle-aged Americans in the early 21st century. They discovered that the mortality development was very adverse for non-Hispanic white Americans starting around the year 2000 up to the present (Figure 1). In all the other countries and also among the US Blacks and US Hispanics, there is a pronounced downward-trend in deaths per 100,000 of men and women (ages 45-55). For the non-Hispanic white Americans, however, there is actually an increase. This increase is so large that the additional deaths, compared to a continued downward trend-line, are comparable to the total human death toll due to the HIV/Aids epidemic in the US.

Why did this trend reversal happen and why was the mortality of non-Hispanic whites increasing during this period? One of the explanations that Case and Deaton favor is the economic crisis which has particularly severe effects on those who rely on capital market based retirement claims. During the economic crisis retirement claims were strongly reduced or became uncertain, so many people became particularly nervous and even desperate.

Another explanation that Case and Deaton (2015) add to this is the increased use of pain killers. Shortly before or just as this increase in mortality started, prescriptions of opioid pain medication surged, so the effect was poisoning caused by the excessive consumption of opioids over a long period. These two main factors are plausible if the cause-of-death statistics are considered. The upward trend in mortality can be fully explained by the increase in suicide, poisoning, and liver disease, which is typically caused by excessive consumption of alcohol or drugs.

Case and Deaton reject the hypothesis that the mortality increase might be caused by obesity and overweight because the increase is apparent both among the obese and the non-obese groups.[3] Other differences provide more insights into this mortality puzzle. While it is visible among the middle and the most educated third of non-Hispanic whites, it is more pronounced among the less educated third of this population. However, the increase is substantially lower among the better educated, pointing to additional pressure that the less educated social strata experienced. Such an increase in mortality is unprecedented in U.S. history (Baten 2016).

Komlos (2016) has recently commented on developments of U.S. inequality, suggesting that since the 1970s, the relative income of the middle class had growth rates barely distinguishable from zero, whereas the richest quantiles of the U.S. population had 3-4 percent growth during this period. This could well result in problematic developments in politics (such as the rise of ultra-populist candidates in U.S. politics), and certainly also health

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[3] For reviews and studies on obesity in general, see Andreyeva, Kelly and Harris (2011); Komlos and Baur (2004).

Another separate issue that might be addressed by further research on the mortality increase is the question of the definition of being white: This definition might have changed due to immigration. For example, immigrants from the Middle East respond as "white" on surveys, of course. I thank Inas Kelly for this suggestion.

behavior could be affected. Similarly, while average incomes did not decline substantially, the U.S. median income has declined since the relatively high level in 1999/2000 according the estimate of the U.S. Bureau of the Census (2016).

While confirming the existence of this mortality surge, other scholars have commented on the timing. Gelman and Auerbach (2016) argued that Case and Deaton's original estimate was based on a mortality rate that did not take into account the age structure within the 45-55 bracket. After adjustments, most of the mortality increase falls into the first period between 1999 until 2005 and is actually stronger for females than for males. This implies that vanishing capital-market based retirement claims were likely no major reason for the mortality increase, as they diminished mostly after 2008. Even though all strata were affected, growing inequality during this period might explain the stronger mortality surge among the less educated. Other factors such as the threat of terrorism after 2001 or the economic challenge of new world market competitors (such as China) might have worried American workers in the Rust Belt more intensively during the early 2000s.[4]

The increase of mortality in a relatively rich society is obviously a paradox. Did such an increase in mortality occur only in the US? Similar phenomena were studied by a number of authors who contributed to the field of economics and human biology. The most dramatic increase in mortality in a relatively rich population took place in the former Soviet Union and other previous socialist countries during the early 1990s. Of course, the situation was different from the US in the 2000s, but both populations were affluent enough that the mortality increase could have been prevented. Another similar aspect is the focus on alcohol and drug consumption: In Russia, middle aged men consumed much higher quantities of alcohol and hard liquor in particular. Stillman (2006) has argued that this was caused by frustration and uncertainty about the future.

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[4] Case and Deaton's argument about the effect of painkillers certainly remains unaffected.

A similar development occurred in East Germany. Following the unification in 1989, available data suggests that the Eastern German population – and mainly the middle age groups around age 40 – experienced deteriorating mortality. Eberstadt (1993) and Riphahn and Zimmermann (1997) have analyzed the determinants of the unexpected demographic development more closely.[5] Again, women were less affected by the changes brought along by the unification. Their data only shows an increase in mortality for women in the age-group 35-45. East German males around the age 40, however, were significantly affected. As late as 1994 this group showed a 10-20 percent increase in mortality compared to data before the unification. Young eastern German males also experienced increased death rates in the first year after the unification; however, their mortality quickly reverted to its original value.

Young people may find it easier to adapt and cope with new situations, whereas men at the age of 40 have reached a life phase in which they are eager to reap the returns from the schooling and human capital investments they may have previously made. Being faced with uncertainty and often unemployment might lead to strong psycho-social stress. Riphahn and Zimmerman's (1997, p.42) results point towards such psycho-social stress, as the increase in mortality of middle aged men was mainly caused by over-consumption of alcohol and by circulatory and cardio-vascular problems.[6]

Considering the effects on both genders, it is interesting to note that women seemed far less sensitive to changes caused by the German unification than men, even though unemployment rose much higher. Overall, female life expectancy actually improved considerably due to falling mortality risks for elderly. In accordance with traditional gender roles, men suffered more severely under psycho-social stress of unemployment and the loss of status than women.

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[5] Cited from Riphahn and Zimmermann (1999)

[6] Another explanation that has not been satisfactorily examined is selective migration: if more healthy people left, mortality rates among the remaining might have increased.

Lipowicz et al. (2016) studied the biological costs of economic transition by considering stress levels during the transition from communism to capitalism in Poland. They assessed a new instrument, the allostatic load, which is a combination of different health factors which, for example, proxy stress, cardiovascular disease, inflammatory phenomena and others and found that the transition from communism to capitalism in the first decade had in fact severe health costs.

Interestingly, in a number of other societies rising uncertainty and economic crisis actually reduced alcohol and drug consumption. Studying the effects of the great recession in Spain, Bassols and Valls' (2016) found that use of a number of drugs, such as cocaine and marihuana increased. The effects were probably small, because only a small minority consumes these drugs in quantities that are hazardous. Simultaneously, alcohol consumption decreased substanially due to the lower purchasing power of many Spaniards. While even unemployed Spaniards might have had a higher income than Russians during the 1990s, the real price of alcohol was higher in Spain and consumption patterns perhaps healthier.

Asgeirsdottir et al. (2016) assessed lifecycle effects of the recession on health behaviours in Iceland and found that the crisis in Iceland was relatively healthy for Icelanders. After the toughest part of the recession was over, the local population continued to practice healthy behaviours.

In sum, the US mortality puzzle is not unique among rich societies during the last decades but the study of Case and Deaton is certainly a milestone towards understanding mortality increases in rich economies. In some societies the middle aged populations react strongly to psychological stress by increasing alcohol and other drug consumption. This might be an early warning signal that should be regularly reported in surveys of national wellbeing.

Puzzle 2: Why are height and income sometimes closely correlated, but not always?

In a study published in this journal, Deaton and Arora (2009) studied height and welfare of US citizens who responded to the Gallup poll. The Gallup-Healthways Well-Being Index daily poll of the US population regularly asked people to report their heights, income, quality of life on a scale from 0 to 10, and whether they experienced enjoyment, physical pain, happiness, worry, sadness, stress, or anger on the previous day. The surprising result of the survey data collected between January 2008 and April 2009 was the strong systematic relationship between height and life satisfaction. Deaton and Arora (2009) found a very close relationship between general satisfaction and height as well as a number of other health indicators. Can this be explained by differences in income and human capital? Income and educational attainment turned out to explain by far the largest part of satisfaction and health in the US.[7]

While the relationship between height, life satisfaction, education and income is quite close in the US, it appears to be less close in global inter-country comparisons. Bozzoli, Deaton and Quintana-Domeque (2009) mentioned the example of the Africa-South Asia contrast, where Africans do better than South Asians on anthropometrics but have a lower income and worse mortality records. They present a theoretical model that suggests selection effects for the case of the African heights paradox, and scarring for South Asians. Perhaps oversimplified, it can be summarized as being based on the idea that only the tallest infants and children in African countries survive, whereas the likelihood of survival is higher for short South Asian children. They provide empirical evidence on this difference, but also

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[7] Similarly four other recent studies found correlations with partner section behavior, entrepreneurship, cognitive skills and education; Sohn (2015) identified a close correlation, such as partner choice between height and other aspects of life satisfactions.
Rietveld et al. (2015) argues that taller persons were more often self-employed and also employed more other employed labourer. Guven and Lee (2015) identify height as a predictor of less cognitive functioning decline at higher ages. Huang et al. (2015) find a surprisingly strong correlation of height and education in the Netherlands during the past world war two period.

suggest further research on this question by summarizing the state of empirical knowledge (Bozzoli, Deaton and Quintana-Domeque 2009, p. 664):

> "More notably, albeit with evidence that is best viewed as suggestive, we find that selection may be stronger than stunting at high levels of mortality and low levels of income, which would explain at least part of the African paradox."[8]

A number of studies aimed to understand the partial correlation on the one hand and the deviation phenomena between height and income on the other. Economic historians found that average heights in the US declined during the middle of the 19th century although GDP per capita grew substantially (for overviews of this "early industrial growth puzzle", see Steckel 2009, Komlos and Baten 2004). Although there has been some debate about selectivity issues, Zimran (2015) argued that this growth puzzle cannot be resolved by resorting to selectivity of sources. Income inequality, urbanization, the spread of diseases and proximity to nutritious food have all been suggested as potential explanations (Komlos and Baten 2004). The latter factor implied that in the early period most people lived close to food production and enjoyed a diet rich in protein, whereas towards the end of the period most Americans lived in urban centers and had a less protein-rich diet (Ibid.).

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[8] They also hint to China with regard to mortality, where during the enormous increase in purchasing power since the mid-1970s infant and child mortality reductions have been modest. A number of authors have contributed to the sometimes unexpected Chinese anthropometric development, such as Li and An (2015) who study the strong intergenerational effects from parents to children, if the parents were born during the "Great Famine" 1959-61. Zong et al. (2015) relate Chinese heights to socioeconomic circumstances. Lu et al. (2016) document the dramatic increase of heights in Beijing. Zhang and Li (2015) find that the increase in birth lengths was actually less than the increase in weight in China after the 1980s.

Akachi and Canning (2015) also studied the relationship between height and GDP for post WWII developing countries. They argued that the contribution of height as a proxy for GDP and live expectancy is particularly important if a country fixed-effects model is used, because the overall correlation in developing countries using DHS-data is not as large as the correlation over time after controlling for county specific fixed-effects.

Could it be that additional variables explain lower heights in South Asia and the taller West Africans, relative to income? Spears (2013) found that access to sanitation is less common in the Indian subcontinent than in other world regions "including Africa" and that this accounts for almost all of the cross-sectional difference between the heights of Indian children and those in Sub-Saharan Africa.[9]

Baten and Blum (2014), taking a larger sample that ranges from the 1810s to the 1980s found a close correlation between height and GDP level. Similarly, Martin and Baten (2016) arrived at a correlation between life expectancy and height for long historical series. However, both long run studies still identified West Africa as a region with taller average heights

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[9] On a related topic Coffey (2015) and Lawson and Spears (2015) assess the effect of early life conditions and the disease environment. Lawson and Spears focus, in particular, on the adult wage, controlling for other confounding factors such as schooling. They find that in India the effect was particularly strong, hence any public health investment would be relatively cheap given the fiscal externalities that arise from an increase in wage.

Another possibility is public health spending bias. Deaton (2009) also notes that surveys often focus on the private spending on health, whereas public expenditure and consumption of public goods are more difficult to report. Hence, an increase in public health spending sometimes leads to a misleading measurement of increasing poverty because the public expenditure crowds out private expenditures and household surveys only measure private expenditure.

Early life conditions even mattered for European countries, as Peracchi and Arcaleni (2011) demonstrated for Italians born in the 1970s: Disease burden and income per capita both mattered, even in rich low-mortality settings, and their relative importance depended on the outcome considered (e.g., height or BMI). Peracchi and Arcaleni also showed that income per capita is a proxy for a variety of indicators that are highly correlated with economic conditions. Among these, particularly important appear to be the incidence of infectious diseases and the quality of the housing stock.

relative to what would be expected based on the income and longevity variables and South Asia as a deviation to the other side. Differentiating by time periods, they found that the strong deviation between height and income was mostly a post-WWII phenomenon, whereas a much closer correlation between the two variables can be observed in earlier periods.

It seems that some developments particular to the post war period are implied in these deviations. Baten and Hatton (2016) argued that the strategy of the Indian government to provide at least grain and rice to the poorest parts of the population that resulted in a unique diet scarce in animal protein, calcium, and iron (even during periods of beginning income and longevity growth) probably played a role. In Africa, the opposite was true: traditional diets rich in protein (especially in the Western Sahel, East and Southern Africa) could not be maintained due to difficult income and health developments in the second half of the 20th century. Further research is clearly needed to assess the relative contribution of these factors and the related arguments of Bozzoli, Deaton and Quintana-Domeque (2009) and Spears (2013) about survival selectivity and access to sanitation. This research field is another example of the inspiring nature of Deatonian puzzles.

Puzzle 3: Height inequality among males and females

The welfare indicator function of human stature has not only been used for average welfare, but also for measuring inequalities (Baten, 2000; Moradi and Baten, 2005). Given that income is an important determinant of height and health in relatively poor societies, these studies found that height inequality tends to correlate with income inequality. This relationship applies to historical populations as well as poor and vulnerable populations today (van Zanden et al., 2014; Blum and Baten 2011).

In his article „Height, health and inequality", Deaton (2008) analyzed whether the distribution of height is correlated with the distribution of expenditure in India. He used the

2005/2006 Indian National Family Health Survey (NFHS) of height, both for males and females, and the 1983 expenditure data for a state level comparison. Deaton found that female height inequality is in fact correlated with expenditure inequality, but that male height inequality is not.

What could be the reason for the correlation between expenditure inequality and height inequality of females, but not males? First of all, one could imagine that in India, which is a society of relative son-preference, women are more vulnerable so that malnutrition disproportionately affects women. As a consequence, female heights would react more sensitively to malnutrition and be a better proxy for poverty. One could even imagine that in regions with a very high son-preference the poorer households allocate an even larger part of medical resources and nutrition to their male offspring which would further increase differences. Additionally, height is of course influenced by income, but income is not the only determinant of height. The disease environment plays a strong role and height is also much more sensitive to the provision of public goods, such as hospitals or other medical services.[10] So it might be that in a region in which a lot of these public health services are provided, height inequality could be lower than income or expenditure inequality (see Moradi and Baten, 2005).

Finally, the original literature on height inequality as a proxy for income inequality stressed strongly that only very homogeneous groups should be used to calculate height inequality. It is, for example, very important that persons who are still growing – and this is the case in developing countries up to an age of twenty or even later – should not be included in the calculation. Furthermore, it is important that cohorts of only a limited number of birth

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[10] In a related research Fiorillo and Sabatini (2015) identify social capital measured by the number of friends met per week as a particularly relevant correlate of health in Italy.

years are used to estimate height inequality because different trends would otherwise also influence the distribution of height.[11]

One conclusion of Deaton's study could be that female height inequality is a better measure for social stratification in developing countries because women are more at risk of malnutrition due to severe poverty.[12] This also corresponds to the fact that most post World War II height inequality studies actually used female height (see Moradi and Baten 2005). The substantial advantage of the height inequality concept is that it allows to measure inequality in periods and regions for which no other inequality measures exist.

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[11] Finally, when using anthropometric and inequality measures, the number of cases plays a large role. There might be a substantial amount of measurement error which has the strongest effect on the relationship between income or expenditure and height inequality if sample sizes are relatively small (such as 26 Indian states in this example). Deaton mentions that one of the major weaknesses of his analysis is that the evidence can only be analyzed on state level because lower aggregation levels are unavailable – mainly due to the data protection rules applied to the 2005/06 NFHS caused by the inclusion of the HIV prevalence in the survey.

On the substantial health differences between Indian states see Lee et al. (2015).

Another implication might be that it could be better to measure inequality using a weighted average of both income and height inequality, if there is evidence that income or expenditure inequality measures are not without measurement error.

Deaton (2008) also analyzes the missing women phenomenon in India and compares it with shorter relative height of women by states. For these two gender inequality measures he finds a substantial correlation. In other studies Deaton comments in great detail on potential measurement errors of expenditure inequality measures which could be a reason for the uncorrelated variation measures of expenditures and height for males here.

[12] Zhang et al. (2015) find that in China the gender-differential of health is particularly strong in the fields of arthritis, angina, eye disease and limited mobility. Nunez and Perez (2015) study height inequality in Chile and find an enormous height inequality in the late 19th and early 20th century. Social economic status differences of 9-11 centimeters are observed in the period until the late 1940s. As social policies were slightly improved thereafter, height inequality declined in Chile.

Puzzle 4: The Indian puzzle of declining calories consumption during periods of sustained income growth

In a study on India, Deaton and Drèze (2009) identified another interesting puzzle; they found that the consumption of calories in this country declined over the last three decades while income grew during the same period (Figure 2). Considering the fact that there was still a very adverse situation of nutrition in India (as the anthropometric height record reveals), Deaton's results turned out to have earned the designation of a puzzle even more.

Deaton and Drèze discuss a large number of potential explanations of which the following are only a selection. One of the potential explanations for declining calorie consumption in times of increasing expenditure might be inequality in India. Calorie consumption may have declined most among the poorest part of the population, remaining constant or even increasing among wealthier people. However, Deaton presents evidence that the increase in income between the mid-1980s and mid-1990s was shared by large segments of the society. In rural areas, incomes of the poorest percentiles grew even faster than those of the richest percentiles in the early period. In the later period growth was more balanced. Only in urban areas the richer segments of society gained more of additional expenditure in the later period. However, overall, the distributional effects of additional income were relatively equally distributed. Deaton concluded that income inequality was probably not the reason for this paradox. Another potential issue could be the difficulty to measure calorie consumption in India, on which Deaton and Drèze spend a substantial amount of discussion.

After discussing other factors, Deaton and Drèze arrived at the conclusion that changes in calorie requirements might have been due to less physical work and activities. The reduction in physical workload allowed spending less income on calories. This explanation is also supported by the fact that the decline in calorie consumption took place in the most

developed parts of India. The overall declining physical activity might still be the most likely explanation.

Another interesting aspect that Deaton mentioned is the composition of the diet. As stated above, even in the 20th century the Indian diet is a frugal one with a very high percentage of grain and rice and correspondingly low shares of animal proteins, fruits, eggs and other more highly priced foodstuffs. This has been noted by a number of authors who estimated that essential minerals and vitamins, animal proteins and fats are lacking. Only 35 percent of the iron demand and 45 percent of the calcium demand (Deaton and Drèze 2009) are represented in the typical Indian diet. Looking at infant diets, one study arrived at the conclusion that only 2 percent of Indian children obtained non-vegetarian foods within their first year (Ibid.). A relatively small share of the Indian population was breast-fed as infants, and only 25 percent were exclusively breast-fed during the first four months. The resulting lack of calcium, iron and animal protein in general might also give us a clue about the decline of calories. The special Indian focus on grain and rice might have represented a disequilibrium of the 1950s to 1980s. With the increase in income during the following period the disequilibrium of consuming much more calories from grain and rice might have been partially rebalanced through other foodstuffs of lower caloric density. Questionnaire results do not seem to confirm this. The share of milk and curd consumption, for example, did not increase, and the growth in fruit and vegetable consumption was modest (ibid.). However, as the questionnaire did not ask for quantity but rather for the fact whether children were given any milk at all, there might be a quantity effect (Baten and Hatton 2016).[13]

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[13] In addition, even if published statistics on animal protein consumption do not indicate an increase, there might be one. Especially milk consumption is often underreported because it is so easily perishable and therefore official statistics did not include all milk and milk products of lower quality (like skimmed milk after removing the fat). Therefore, the consumption volume could still have grown even if the official statistics do not indicate it. We observe this in many statistics, both in historical

In conclusion, the decline of Indian consumption of calories during the income growth in the last three decades is another inspiring Deatonian puzzle. Deaton and Dreze explained it with declining physical workload and activity, which is highly plausible. In addition they mentioned the composition of the diet, which might have played an additional role.

Conclusion

It is fascinating to see how much research Deaton has conducted in the field of economics and human biology. He also advocated for more research in this field, stressing that it might yield more value-added than studies of material welfare (even if it clearly cannot be a substitute):

> "It is perhaps tempting to abandon measures of material well-being and move to other measures, such as anthropometrics, or mortality, and I believe that the material poverty measures have been assigned too much weight, given their inherent unreliability. Yet, while it is surely important to emphasize other aspects of poverty, particularly health and education, those other dimensions are not substitutes for measures of material deprivation." (Deaton 2016, p. 1225)

One of the inspiring strategies that he has used in this field is the identification of puzzles. Outlying cases in otherwise relatively consistent relationships are inspiring for all economists and other scholars, who are interested in these fields. This strategy is not only intellectually exciting, but also leads to better adapted economic policy measures; if the mortality of middle aged Americans increased in spite of sufficient income for a healthier life style, there is scope for health policy and behavioral improvement. Similarly, if Indian incomes are increasing, but the consumption of calories decline (and malnutrition is still

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time series and today. For an overview, see Baten and Blum (2014), from an anthropological perspective: Grasgruber et al. (2016).

prevalent among the poorer strata and among women), more intelligent health policies need to be developed. Tools to assess the success of these policies – such as using height inequality and average height measures as indicators – also benefit from carefully assessing the puzzles that arise in applied empirical work. Deaton's research and the studies in this volume (and in this journal) promise that aiming to understand the complicated and multifaceted relationship between economics and human biology will yield many exciting results.

References:

Akachi, Y. and D. Canning (2015). "Inferring the economic standard of living and health from cohort height: Evidence from modern populations in developing countries" *Economics and Human Biology* 19, pp. 114-28.

Andreyeva T., Kelly I.R., Harris J.L. (2011). "Exposure to food advertising on television: Associations with children's fast food and soft drink consumption and obesity" *Economics and Human Biology* 9, pp. 221-233.

Asgeirsdottir, T. Laufey, H. Corman, K. Noonnan and N.E. Reichman (2016). "Lifecycle effects of a recession on health behaviors: Boom, bust, and recovery in Iceland" *Economics and Human Biology* 20, pp. 90-107.

Bassols Martin, N. and J. Vall Castelló (2016). "Effects of the great recession on drugs consumption in Spain" *Economics and Human Biology* 22, pp. 103-116.

Baten, J. (2000). "Economic Development and the Distribution of Nutritional Resources in Bavaria, 1797-1839" *Journal of Income Distribution* 9, pp. 89-106.

Baten, J. (ed.) (2016). *A History of the Global Economy. 1500 to the Present*. Cambridge: Cambridge University Press.

Baten, J. and M. Blum (2014). "Why are you tall and others are short? Agricultural production and other proximate determinants of global heights" *European Review of Economic History* 18, pp. 144-65.

Baten, J. and T. Hatton (2016). "Why have the Heights of Indians Increased so Slowly?", *Working Paper, Univ. Tuebingen.*

Blum, M. and J. Baten (2011). "Anthropometric within-country Inequality and the Estimation of Skill Premia with Anthropometric Indicators" *Review of Economics -- Jahrbuch fuer Wirtschaftswissenschaften* 62-2, pp.107-138.

Bozzoli, C., A. Deaton, and C. Quintana-Domeque (2009). "Adult Height and childhood disease" *Demography* 46-4, pp. 647-669.

Case, A. and A. Deaton (2015). "Rising Morbidity and Mortality among White Non-Hispanic Americans in the 21st Century" *PNAS* 112-49, pp.15078-15083.

Coffey, D. (2015). "Early Life mortality and Height in Indian States" Economics and Human Biology 17, pp. 177-89.

Deaton, A. (2008), "Height, Health and Inequality: The Distribution of Adult Height in India" *American Economic Review* 98-2, pp. 468-474.

Deaton, A. (2016), "Measuring and Understanding Behaviour, Welfare and Poverty" *American Economic Review* 106-6, pp. 1221-1243.

Deaton, A., and R. Arora (2009). "Life at the Top: the Benefits of Heights" *Economics and Human Biology* 9, pp. 133-136.

Deaton, A., and J. Drèze. 2009. "Food and Nutrition in India: Facts and Interpretations" *Economic and Political Weekly* 44-7: 42–65.

Eberstadt, N. (1993). "Mortality and the Fate of Communist States" *Communist Economies and Economic Transformation* 5, pp. 499-517.

Fiorillo, D. and F. Sabatini (2015). "Structural Social Capital and Health in Italy" *Economics and Human Biology* 17, pp. 129-42.

Gelman, A. and J. Auerbach (2016), "Age-aggregation bias in mortality trends" *Working Paper, Columbia University*.

Grasgruber, P., M. Sebera, E. Hrazdíra, J. Cacek and T. Kalina (2016). "Major correlates of male height: A study of 105 countries" *Economics and Human Biology* 21, pp. 172-195.

Guyen, C. and W.S. Lee (2015). "Height, Aging and Cognitive Abilities across Europe" *Economics and Human Biology* 16, pp. 16-29.

Huang, Y., F. van Poppel and L.H. Lumey (2015). " Differences in Height by Education among 371,105 Dutch Military Conscripts" *Economics and Human Biology* 17, pp. 202-07.

Komlos, J. (2016). Growth of Income and Welfare in the U.S, 1979-2011. *NBER Working Paper* 22211.

Komlos, J. and Baten, J. (2004), "Looking Backward and Looking Forward: Anthropometric Research and the Development of Social Science History" *Social Science History* 28-2, pp. 191-210.

Komlos, J. and Baur, M. (2004). "From the tallest to (one of) the fattest: The enigmatic fate of the American population in the 20th century" *Economics and Human Biology* 21, pp. 57-74.

Lawson, N. and D. Spears (2015). "What doesn't kill you makes you poorer: Adult wages and early-life mortality in India" *Economics and Human Biology* 21, pp. 1-16.

Lee, J., M.E. McGovern, D.E. Bloom, P. Arokiasamy, A. Risbud and J. O'Brien (2015). "Education, gender, and state-level disparities in the health of older Indian: Evidence from biomarker data" *Economics and Human Biology* 19, pp. 145-56.

Li, Q. and L. An (2015). "Intergenerational Health Consequences of the 1959-1961 Great Famine on Children in Rural China" *Economics and Human Biology* 18, pp. 27-40.

Lipowicz, A., A. Szklarska and A.W. Mitas (2016). "Biological costs of economic transition: Stress levels during the transition from communism to capitalism in Poland" *Economics and Human Biology* 21, pp 90-99.

Lu, Ruoran, Xiapeng Zen, Jiali Duan, Ting Gao, Da Huo, Tao Zhou, Yi Song, Ying Deng and Xiuhua Guo (2016). "Secular growth trends among children in Beijing (1955-2010)" *Economics and Human Biology* 21, pp 210-220.

Martin, L. and J. Baten (2016). "Inequality and Development in Africa and Asia, 1820-2000. Assessing the Correlation Between Life Expectancy and Income Inequality Using Anthropometrics" *Working Paper Univ. Tuebingen.*

Moradi, A. and J. Baten (2005). "Evolution of Living Standards Inequality in Sub-Saharan Africa 1950-80: New Estimates and New Results" *World Development* 33-8, pp. 1233-1265.

Nunez, J. and G. Perez (2015). "Trends in Physical Stature across Socioeconomic Groups of Chilean Boys, 1880-1997" *Economics and Human Biology* 16, pp. 100-114.

Peracchi, F. and E. Arcaleni (2011). "Early-life environment, height and BMI of young men in Italy" *Economics and Human Biology* 9, pp. 251-264.

Rietveld, C., J. Hessels and P. van der Zwan (2015). "The Stature of the Self-Employed and Its Relation with Earnings and Satisfaction" *Economics and Human Biology* 17, pp. 59-74.

Riphahn, R.T. and K.F. Zimmermann, "The Transition's Mortality Crisis in East Germany," *UNU/WIDER - Research for Action* 42 (1997), pp. 9-10.

Sohn, K. (2015). "The Value of Male Height in the Marriage Market" *Economics and Human Biology* 18, pp. 110-24.

Spears, D. (2013). "How much International Variation in Child Height can Sanitation Explain?" *World Bank Policy Research Working Paper* 6351.

Steckel, R. (2009). "Heights and human welfare: recent developments and new directions", *Explorations in Economic History* 46, 1-23.

Stillman, Steven (2006). "Health and Nutrition in Eastern Europe and the Former Soviet Union during the Decade of Transition: A Review of the Literature" *Economics and Human Biology* 4-1, pp. 104-46.

US. Bureau of the Census, Real Median Household Income in the United States [MEHOINUSA672N], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MEHOINUSA672N, October 21, 2016.

van Zanden, J.L., J. Baten, P. Földvari and B. van Leeuwen (2014). "The Changing Shape of Global Inequality 1820-2000. Exploring a New Dataset" *Review of Income and Wealth* 60-2, 279-297.

Zhang, H., T. Bago d'uva and E. van Doorslaer (2015). "The Gender Health Gap in China: A Decomposition Analysis" *Economics and Human Biology* 18, pp. 13-26.

Zhang, Y. and H. Li (2015). "Changes in weight, length, head circumference, and ponderal index at birth of healthy term newborns in nine cities in China during the period of rapid social development 1985-2005" *Economics and Human Biology* 19, pp. 45-50.

Zimran, A., 2015. "Does Sample-Selection Bias Explain the Industrialization Puzzle? Evidence from Military Enlistment in the Nineteenth Century United States". *Working Paper: Northwestern Univ*.

Zong, X.-N., H. Li, H.-H. Wu and Y.-Q. Zhang (2015). "Socioeconomic development and secular trend in height in China" *Economics and Human Biology* 19, pp 258-64.

Figure 1: The puzzle of increasing mortality in the U.S. (age 45-54): non-hispanic U.S. whites, in comparison with U.S. hispanics and selected other country populations, 1990-2012
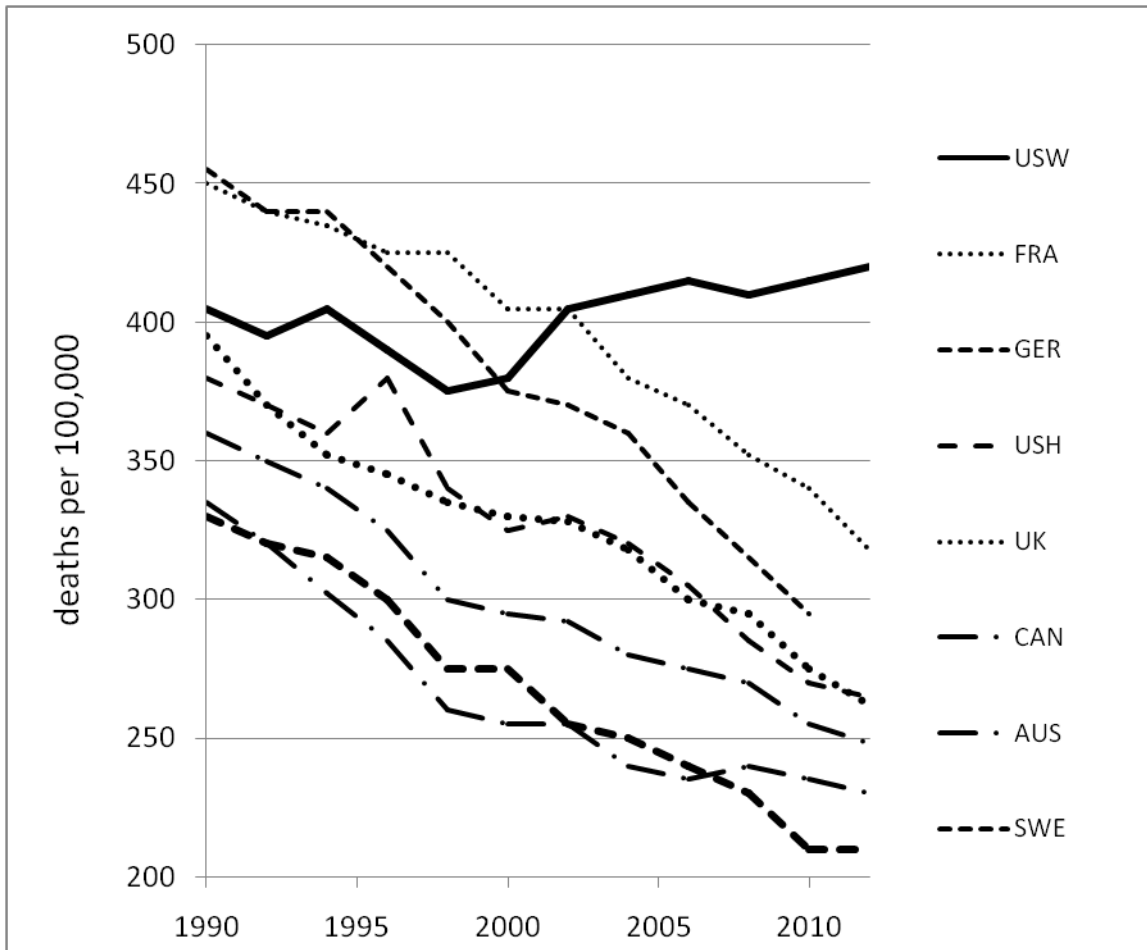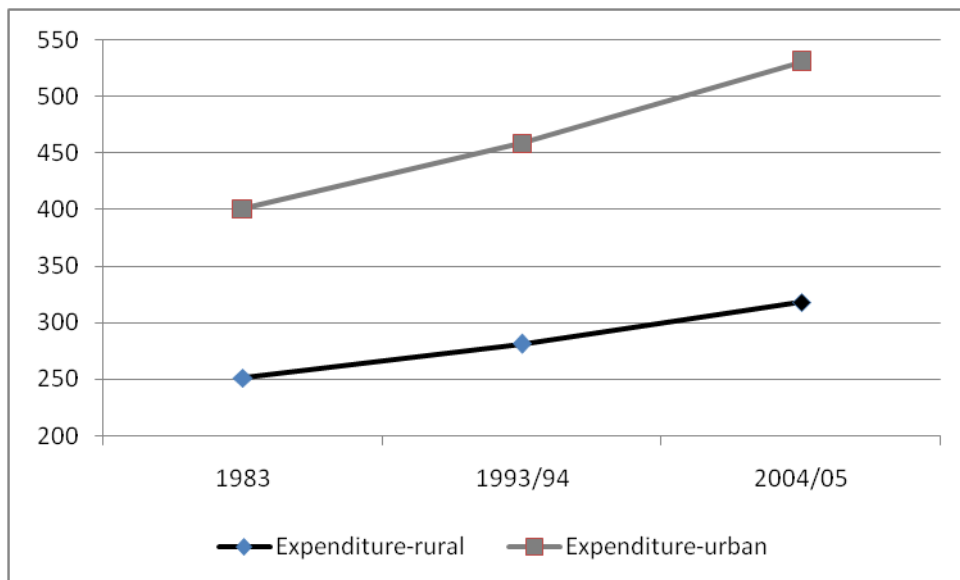

Source: modified from Case and Deaton (2015). Abbreviations: AUS Australia, CAN Canada, GER Germany, FRA France, UK United Kingdom, USH U.S. hispanics, USW U.S. whites, SWE Sweden

Figure 2: The puzzle of falling calorie consumption in India, at a time of increasing expenditure

Panel A: Calories (kc per capita and day)
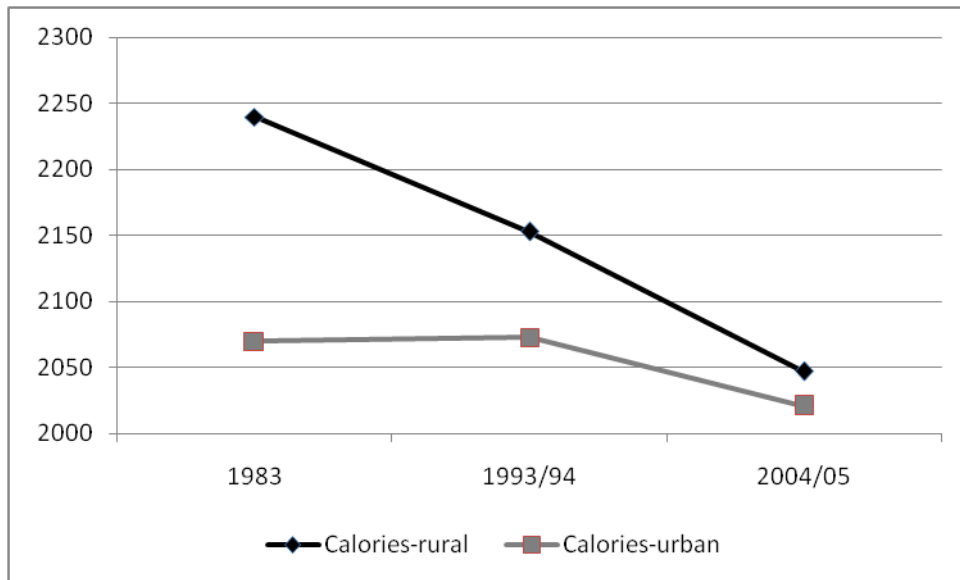
Panel B: Expenditure (real Rs. per capita)

Source: modified from Deaton and Dréze (2009).