Preface

No country in the world has a more bountiful food supply than the United States. Not only are American farmers remarkably productive but our surpluses are an important part of the supply of food to the rest of the world. Nor is this abundance a recent development. American agricultural surpluses have been a major factor in U.S. exports, going back more than three centuries. In addition to exporting such nonfood crops as tobacco and cotton during the eighteenth and nineteenth centuries, the U.S. exported grains, meat, and fish to the Caribbean and Europe in increasing amounts. As late as the end of the nineteenth century, the U.S. not only had higher caloric consumption per capita but a larger proportion of calories originating in meat and fish than any other country in the world.

At the end of the nineteenth century, for example, the consumption of meat per capita in the U.S. was twice as high as in Germany, more than 3 times as high as in the Netherlands and Russia, 2.5 times as high as in France, 1.8 times as high as in England, and 8 times as high as in Italy. A lush supply of food, however, does not necessarily mean good nutrition.

When stature and the body mass index (BMI) are used as proxies for nutritional status, it becomes apparent that despite the vast food supply of the second half of the nineteenth century native-born males in the United States were chronically malnourished (stature at maturity was only at the twenth-fifth centile of the current standard). Males in their thirties had a BMI of about 21, which is about 4 BMI points below the current average. Regressions relating height and BMI to the odds of developing chronic disease at middle and late ages were quite significant. The studies of the nineteenth and twentieth centuries point to the existence of a synergism between technological and physiological improvements that has produced a form of human evolution that is biological but not genetic, rapid, culturally transmitted, and not necessarily stable. This process is still ongoing in both rich and developing countries and has been referred to as "techno-physio evolution."

Unlike the genetic theory of evolution, the theory of technophysio evolution rests on the proposition that during the last 300 years, particularly during the last century, human beings have gained an unprecedented degree of control over their environment—a degree of

control so great that it sets them apart not only from all other species, but also from all previous generations of Homo sapiens. This new degree of control has enabled Homo sapiens to increase its average body size by over 50 percent, to increase its average longevity by more that 100 percent, and to improve greatly the robustness and capacity of vital organ systems.

The most important aspect of technophysio evolution is the continuing conquest of chronic malnutrition due mainly to a severe deficiency in dietary energy, which was virtually universal three centuries ago. In France at the beginning of the nineteenth century, for example, the amount of energy available for work per equivalent adult male was less than one-third of the current U.S. supply of energy for work. As a consequence, mature Frenchmen were only about 163 centimeters tall on average and weighed about 50 kilograms.

Recent studies have estimated that variations in nutritional status are associated with variations in chemical composition of the tissues that make up vital organs, in the quality of electrical transmissions across membranes and in the functioning of the endocrine system and other vital systems. Nutritional status thus appears to be a critical link connecting improvements in technology to improvements in human physiology.

So far I have focused on the contribution of technological change to physiological improvements. The process has been synergistic, however, with improvement in nutrition and physiology contributing significantly to the process of economic growth and technological progress along the lines that I have described elsewhere. Here I merely want to point out the main conclusion. Technophysio evolution appears to account for about half of British economic growth over the past two centuries. Much of this gain was due to the improvement in human thermodynamic efficiency. The rate of converting human energy input into work output appears to have increased by about 50 percent since 1790.

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