

**ATTACHMENT A.**

**DEFINITIONS OF GROWTH, WELL-BEING AND RELATED KEY CONCEPTS**

**ATTACHMENT A.**

**DEFINITIONS OF GROWTH, WELL-BEING AND RELATED KEY CONCEPTS**

1. DEFINITIONS

2. LIMITS AND CONSTRAINTS ON THE RATES AND LEVELS OF GROWTH

3. THE RHETORIC OF GROWTH

4. CAN WE MEASURE WELL-BEING?

Addendum (2018)

## ATTACHMENT A. DEFINITIONS OF GROWTH, WELL-BEING AND RELATED KEY CONCEPTS

[Attachment A is from Hayes (2004; Appendix 5) and will be revised and updated for the final working paper.]

### 1. DEFINITIONS

As most commonly used, the word “growth” simply means an increase. In many contexts “growth” applies more generally to any change over time, and thus includes negative growth. In these notes we might be interested in the growth, or change over time, of output, consumption, utility (or welfare, well-being or happiness), throughput (or resource use), population, pollution, the stock of natural or human-made capital, information, complexity or any of many other things.

For our purposes it is particularly important to have clear definitions of *well-being*, *throughput* and *output*. There is a large literature on how these might be defined and measured, but the rough definitions below will suffice for now.

“Well-being” refers to the most general, inclusive sense of human satisfaction and contentment. The question “what determines well-being?” is among the most important questions there are.

“Throughput” is the flow of natural resources used to generate output. Some throughput generates output directly, but most becomes output only after a series of manipulations. During these manipulations some of the throughput becomes waste. Particular flows of resources can be easily measured but there is no practical common unit with which to measure throughput in the aggregate.

“Output” is throughput manipulated by human activities intended to increase well-being. It can equivalently be defined as all final goods and services produced by an economy during a time period. To the extent that prices reflect value, output can be measured as the sum of the prices of these goods and services, or gross domestic product (GDP). The proper measurement of output, or GDP, should include imputed prices for both positive and negative non-market goods. While any particular act of producing output is intended to increase well-being, it may not. As defined here output has an important bearing on well-being but is not synonymous with it. In these notes the term “economic growth” is used to mean the growth of output.

Well-being, throughput and output can each increase, decrease or remain constant. We can imagine  $3^3 = 27$  scenarios, some more plausible than others, showing how these three variables might change with respect to one another over time. Three scenarios are shown in Figures 1, 2 and 3 in **Box A-1**.

Figure 1 illustrates a conventional interpretation of the historical experience of the industrial world over the past three centuries or so. Greater throughput enables production of more output, which increases well-being.

Figure 2 is a “green” scenario. Technological innovation allows a constant level of output to be produced with less throughput, while skillful craftwork changes qualities of that output in such a way that well-being increases.

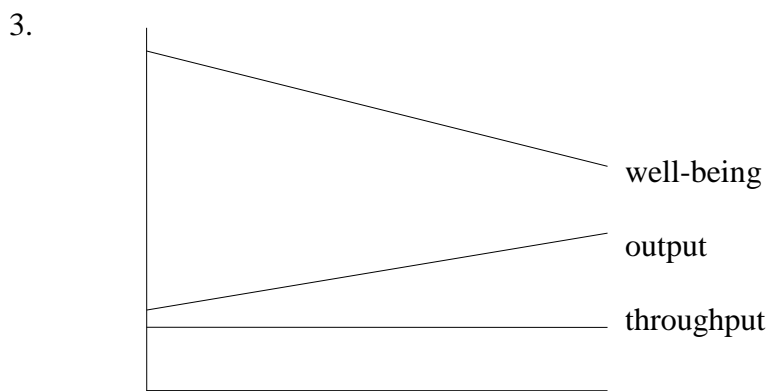
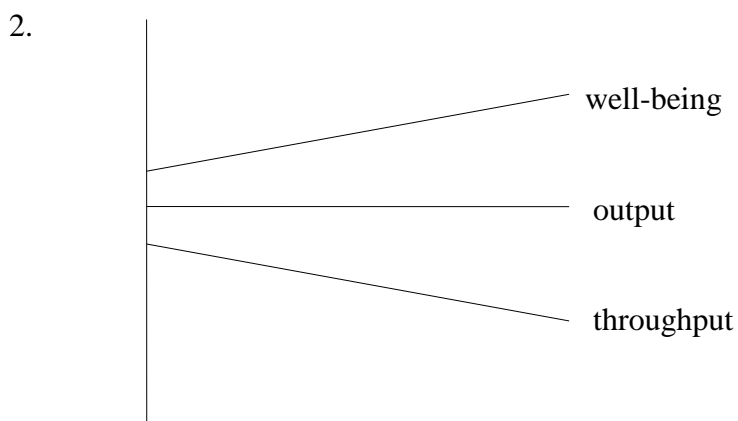
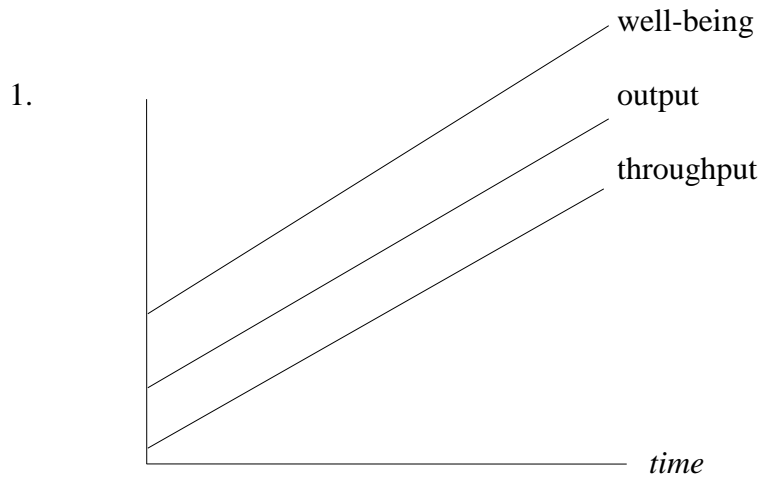
Figure 3 is a mixed bag. A constant level of throughput is maintained, perhaps because a transition to a renewables-based economy has been successfully completed. And technological innovation is robust enough to generate a steady increase in output. But well-being declines nonetheless, perhaps because this materially sustainable, technologically productive world is being run as an increasingly authoritarian police state.

As defined, output represents a link between the fundamentally more significant variables of well-being and throughput. Output is of interest to us primarily because it contributes to well-being and uses throughput.

The five scenarios shown in Figures 1 through 5 in **Box A-2** dispense with “output” and illustrate different sorts of relationships that may obtain more directly between the level of well-being and the level of throughput.

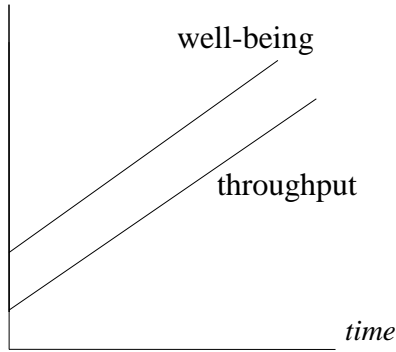
### BOX A-1. WHAT GROWS? (1)

The figures show well-being, output and throughput increasing, decreasing and remaining constant over time.

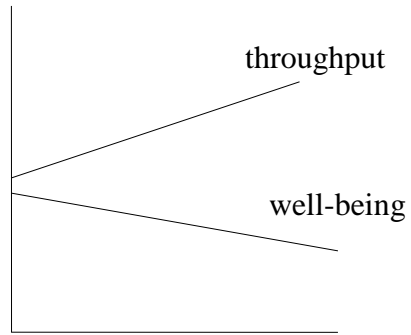


**BOX A-2. WHAT GROWS? (2)**

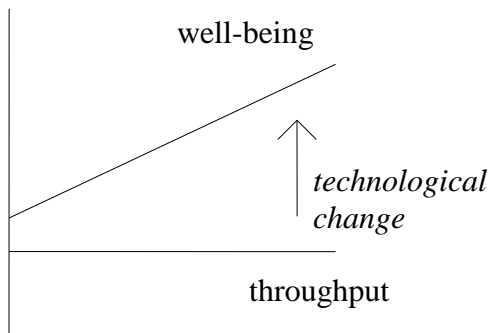
The figures show different ways in which trajectories of throughput might bear upon trajectories of well-being, as discussed in the text.



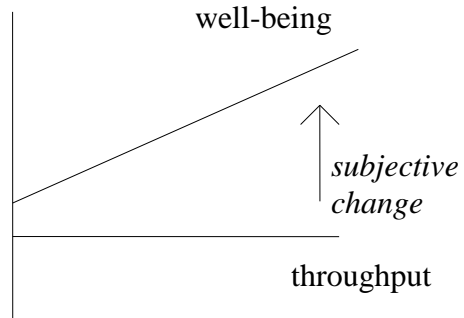
1. "the metal eaters"



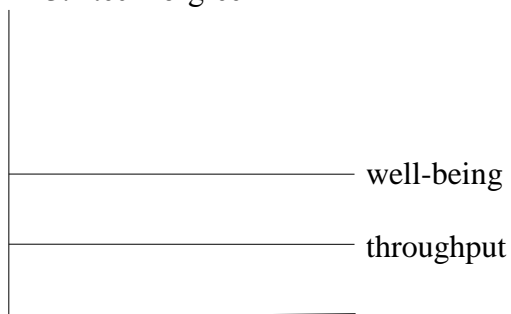
2. "gloomy Sunday"



3. "techno-green"



4. "subjective green"



5. "green minimal claim"

Figure 1 illustrates, once more, the conventional account.<sup>1</sup>

Figure 2 shows the unhappy case in which throughput continues to grow but well-being declines.

Figures 3 and 4 are both green scenarios and show the same formal relationship between throughput and well-being, but they are driven by very different processes and represent very different outcomes. Figure 3 shows the “techno-green” scenario. Human technological skill allows a constant level of throughput to be manipulated in increasingly efficient and innovative ways. As a result, human well-being can increase without endangering the environment.

Figure 4 is the “subjective-green” scenario. It shows a constant level of throughput, but this time there are no technological improvements. The same stuff is made in the same way, century after century. However, the quality of the services provided by the output improves. The design and construction of a saxophone may not change over the course of a century, but the beauty and variety of the compositions written for it, and of the performances given with it, can grow indefinitely.

There is a second, more subtle interpretation of the scenario shown in Figure 4. Neither the saxophone, the compositions, nor the performances change over the course of time, but the listeners develop an increasingly keener appreciation for the music. Throughput remains constant but well-being grows.

Figure 5 is the “green minimal claim” scenario. The minimal claim is simply that a constant level of throughput can indefinitely support some constant, fulfilling level of well-being.

## 2. LIMITS AND CONSTRAINTS ON THE RATES AND LEVELS OF GROWTH

The phrase “limits to growth” is ambiguous because the thing whose growth is limited is unspecified. It is also ambiguous because “growth” can refer either to the *rate* of growth or to the *level* to which something can grow. We can say that output (for example) is limited to a growth rate of 2% per year, or that output is limited to an absolute level of \$30 trillion. Note that a limit to the level of growth implies an eventual limit to the rate of growth, i.e., 0%.

The term “limits” can be used to mean either an absolute level that cannot be exceeded, or a softer set of constraints short of an absolute limit. In this exercise we try to use “limits” when speaking of values that cannot be exceeded, and “constraints” for the more general set of impediments. As used here, “constraints” is the inclusive term: a limit is a very strong constraint, but a constraint need not, although it might, impose a limit.

Thus we can speak, hopefully unambiguously, of limits to the level to which something can grow, limits to the rate at which something can grow, constraints on the level to which something can grow, and constraints on the rate at which something can grow.

## 3. THE RHETORIC OF GROWTH

President Ronald Reagan once offered the opinion that “there are no limits to growth, because there are no limits to the human imagination.” Put less succinctly but more precisely, he might have been expressing the opinion that there are no limits to the ability of humanity to technologically manipulate any given level of throughput such that human well-being continues to increase.

Some environmentalists say, “There are limits to growth, but not to well-being.” One interpretation of this statement might be that technological or social innovation will allow us to manipulate an environmentally sustainable, constant level of throughput in a way that can allow human well-being to increase indefinitely.

---

<sup>1</sup> “The metal eaters” is a translation of “Металлические едоки,” used by Russian environmentalists to describe the institutions of industrial civilization.

Other environmentalists say, “There are limits to *throughput*, but there are *no* limits to *growth*.” In the previous statement “growth” referred to throughput, but here it could refer to well-being, or to output, or to both well-being and output.

#### 4. CAN WE MEASURE WELL-BEING?

The Standard National Accounts were developed in the 1940’s in order to track the flows of economic variables, including output, consumption, savings, investment, the supply of money and public spending, that were needed to help develop policies intended to ensure steady output growth, low inflation and low unemployment. Especially in the wake of the Great Depression and the Second World War, a steady growth in output was experienced by most persons as a major contribution to well-being. The availability of Gross Domestic Product (GDP) as an analytically convenient measure of output led to its identification among economists, political leaders and the public as a measure of well-being.

The inadequacies of conventional GDP as a measure of both output and well-being are well known. Its major inadequacy as a measure of output is that it doesn’t account for goods or bads external to the market.

Attempts to address the shortcomings of the GDP have gone in two directions. One is to improve its usefulness as a measure of output, while claiming only a partial role for it as a measure of well-being. This entails converting as many non-market goods and bads as possible into dollar terms and incorporating these into the national income accounts, and other reforms.

A second direction seeks to devise genuine measures of well-being which over time could supplement or supplant GDP in that role. One approach involves the use of (fully inclusive) GDP in association with satellite accounts of variables that are judged to have a bearing on well-being, such as longevity, infant mortality, literacy or stocks and flows of natural resources. A second approach is to combine these measures into a single statistic by means of an indexing formula. The choice set of satellite accounts, and any indexing weights they might be given, are of course strongly normative statements.

Some examples of efforts along the lines described are shown in **Box A-3**. Figure 1 shows the measure that Nordhaus and Tobin (1989) call Net Economic Welfare (NEW). NEW takes Net National Product, which is GNP less depreciation, and adds the value of leisure time, domestic activities, “underground” transactions, and other non-market goods. It subtracts non-market bads such as economic damages resulting from pollution and urban congestion. Nordhaus defines NEW as “an adjusted measure of total national output that includes only consumption and investment items that contribute directly to economic well-being.” In general, the growth rate of NEW has paralleled the growth rate of conventional GDP.

Figure 2 displays the Genuine Progress Indicator (GPI) developed by the organization Redefining Progress (1995), based on work by Daly and Cobb (1989). Like NEW, the GPI adds the value of domestic activities to GDP. However, the GPI shows a decrease in leisure time rather than an increase. In the GPI environmental pollution and resource depletion reduce GDP by larger amounts than they do in the NEW. In addition, GPI incorporates an indexing factor that records the growth of economic inequality as a decrease in well-being. These plus other modifications of the GDP accounts generate a path over time very different from that displayed by NEW.

Figure 3 shows the Human Development Index developed by the United Nations Development Program (1996). This relatively simple index has three components: life expectancy, educational attainment (based on adult literacy rates and mean years of schooling), and adjusted income. Income is GDP per capita computed on a Purchasing Power Parity basis, subject to a strongly diminishing marginal index value.

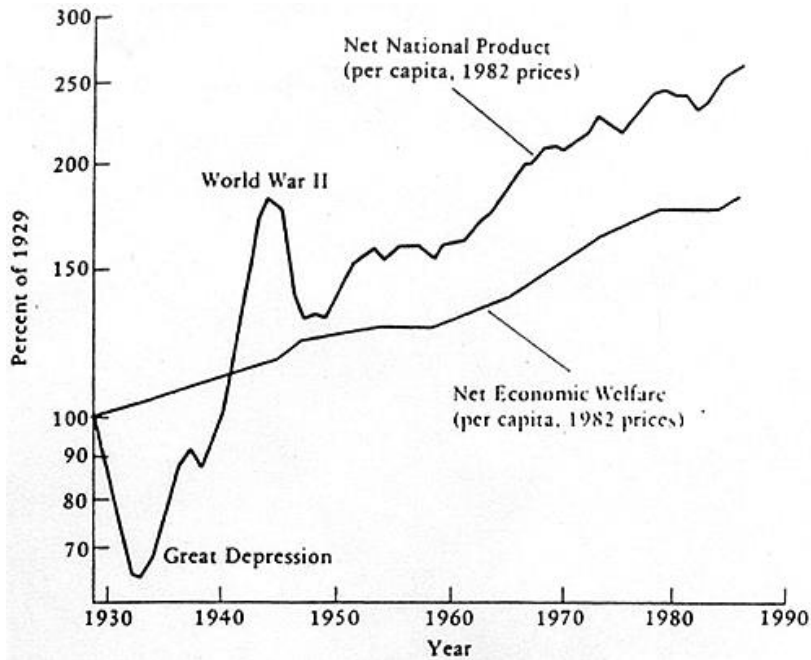
Easterlin (1995) doubts that any set of objective measures can accurately model all the determinants of well-being, and suggests that surveys of how people assess their own well-being can provide a better guide. Figure 4 shows how people in the United States responded to a question asking them how happy they are. The slight trend shown

### BOX A-3. MEASURING WELL-BEING

These figures illustrate how differing measures of well-being have changed in recent years.

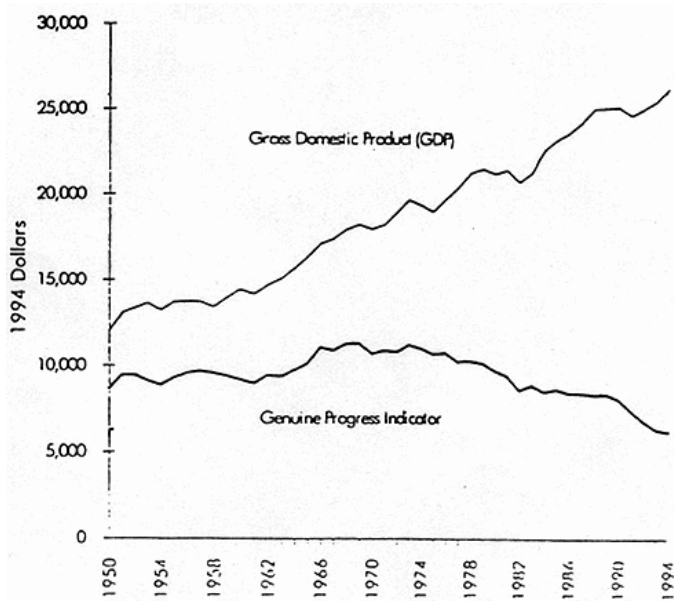
**Figure 1. Net Economic Welfare**

(Reprinted from Samuelson and Nordhaus, 1989, p 119)



**Figure 2. GPI versus GDP**

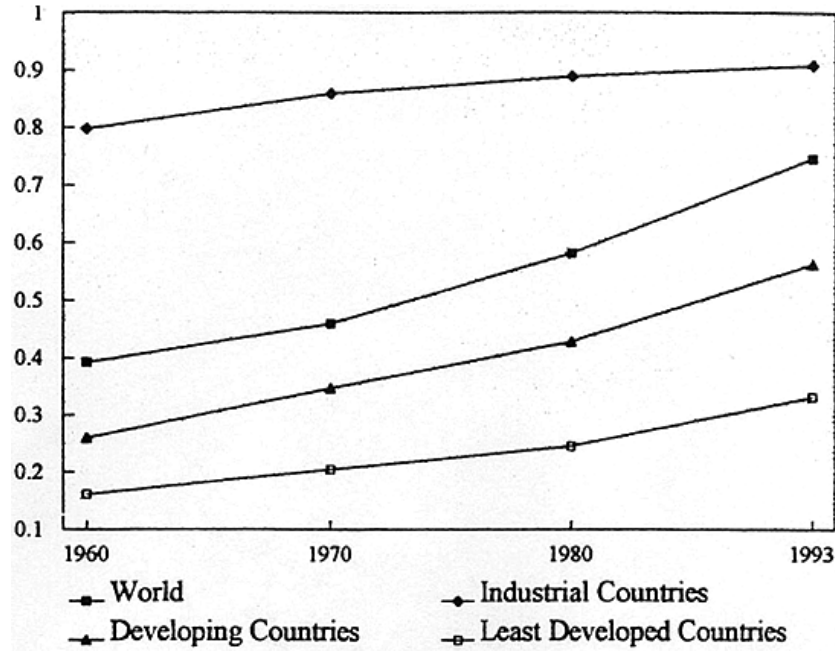
(Reprinted from Redefining Progress, 1995)



**BOX A-3. MEASURING WELL-BEING (cont.)**

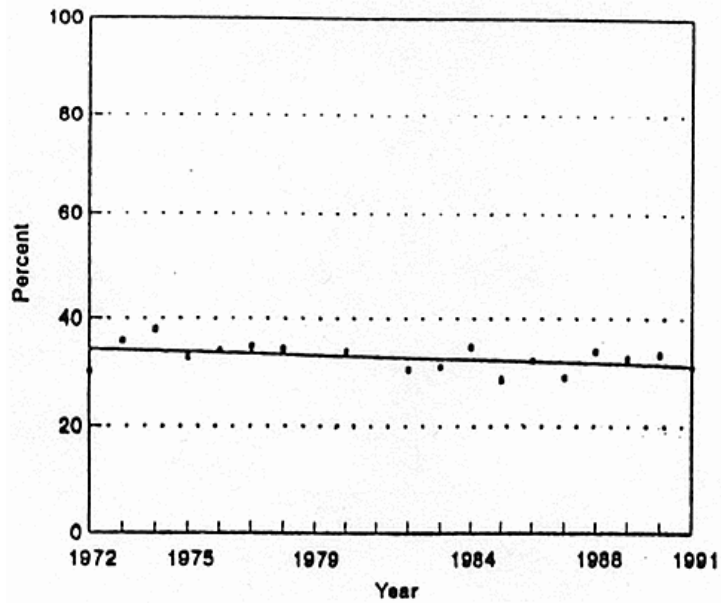
**Figure 3. Human Development Index, 1960-1993**

(United Nations Development Program, Human Development Report, 1996)



**Figure 4. Happiness**

(Reprinted from Easterlin, 1995)



The vertical axis shows the “percent very happy,” based on National Opinion Research Center surveys through 1991.

by the regression line is not statistically significant. Reported happiness in the United States over the past twenty years has been constant, despite a major increase in output during that time.

Applied to the United States, these alternatives to conventional GDP move in different ways over time. The NEW and HDI increase, the GPI decreases, and the proportion of people stating that they are happy remains unchanged.

# # #

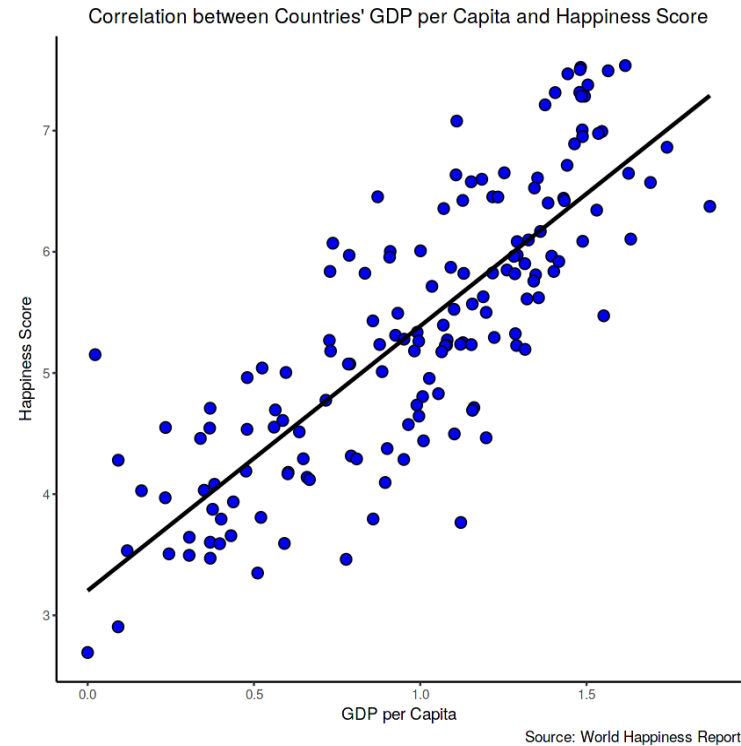
### Addendum (2018)

As noted, the material in this Attachment above was gathered in 2004, and there have been many developments regarding definitions and measurements of growth, well-being and related concepts since then.

Among the topics given increasing attention over this period has been the possibility of measuring “Happiness,” with particular attention to the prospect of using it as a more meaningful measure of well-being than, say, GDP. Two examples are shown below.

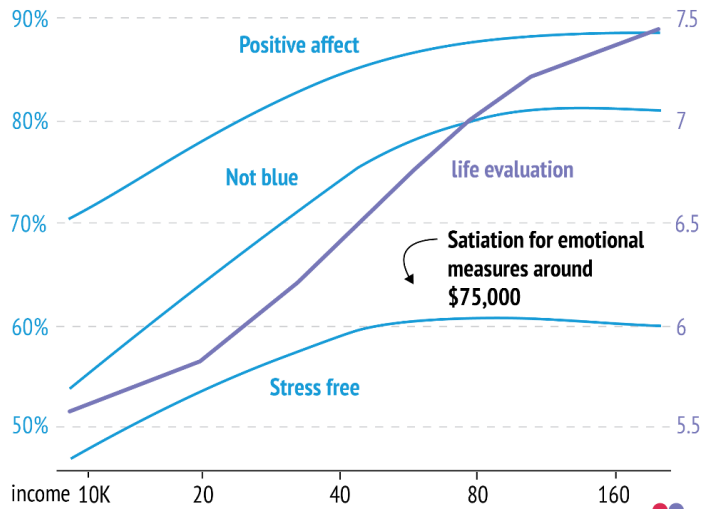
**CHART A**, using data from the [World Happiness Report \(2016\)](#), suggests that the correlation between Happiness and per capita GDP across countries is strong.

### CHART A



**CHART B** shows the results [of a study by Kahneman et al. that distinguished between two measures of subjective well-being](#). **Emotional well-being** measures the net effect of “everyday experiences... joy, stress, anger, sadness...- that make one’s life pleasant or unpleasant.” **Life evaluation** refers to “the thoughts that people have about their life when they think about it.” The study found that life evaluation rose steadily as income rose. Emotional well-being also rose as income rose, but only to an income level of about \$75,000, after which emotional well-being remained constant.

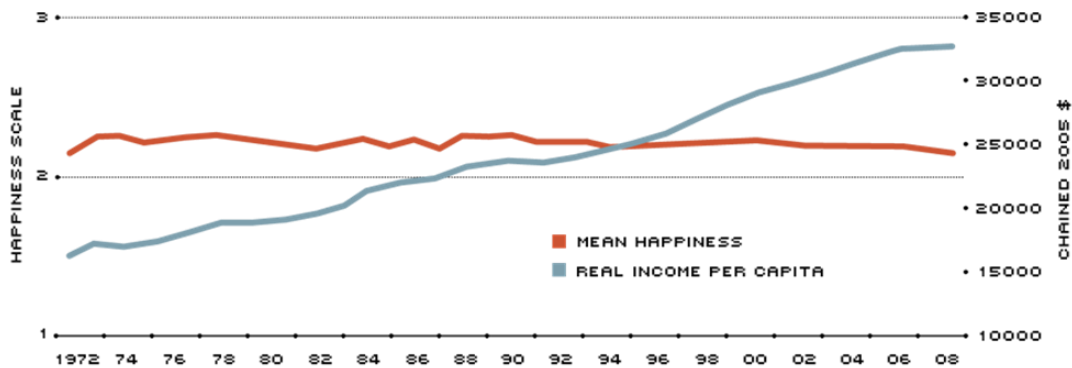
**CHART B. High income improves evaluation of life but not emotional well-being.**



Source: Kahneman, Daniel and Angus Deaton. 2010. “[High income improves evaluation of life but not emotional well-being.](#)” *Proc Natl Acad Sci USA*. 21 September.

**CHART C** shows the time series relationship between Happiness and per capita income in the US for 1972-2008. Although per capita GDP has almost doubled, reported Happiness has not changed much at all. This is consistent with our closing summary of the 2004 material above.

**CHART C. Time-Series Comparison of Happiness and Per Capita Income, 1972-2008.**



Source: Hernández-Murillo, Rubén and Christopher J. Martinek. 2010. “[The Dismal Science Tackles Happiness Data.](#)” Federal Reserve Bank of St. Louis: *The Regional Economist*. January.

These three examples, along with the earlier material, raise a host of questions. A full review of studies, with attention to definitions, methodology, data sources and more, is needed before firm conclusions can be drawn.