Macro Theory III.
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GDP at PPP or World Prices

The Summers and Heston Penn World Table data are constructed as follows:

Given are

(1) $\{I_i\}$ a partition of the space of final goods (and services). N_i is the number of elements of I_i.

(2) Total expenditures E_i^j on goods in category i in country j in national currency units.

(3) Prices of a subset of the goods p_k^j in national currency units.

Step 1: Construct a price index for category I_i good in country j

$$P_i^j = \left[\prod_{k \in I_i} p_k^j \right]^{1/N_i}.$$

Step 2: Construct the quantities of category i goods

$$X_i^j = \frac{E_i^j}{P_i^j}.$$

Problem: Given the quantities X_i^j and prices P_i^j for all the categories of goods, for all the countries in the world w, construct purchasing power parity GDP's . Summers and Heston use the Geary-Khamis approach, which is as follows:

$$P_i^w = \sum_j \frac{X_i^j}{X_i^w} \frac{P_i^j}{PPP^j}$$

$$PPP^j = \frac{P^j \cdot X^j}{P^w \cdot X^j}.$$

In the above $X_i^w = \sum_j X_i^j$, P and X without a subscript are vectors, and the dot denotes the dot product.

Note: The above is a system of simultaneous equations that must be solved for PPP^j and P_j^w. The system is homogenous of degree one in prices and therefore does not have a unique solution. For uniqueness, a normalization is required. The standard normalization is $PPP^{U.S.} = 1$. With this normalization, prices P_i^j are in U.S. dollars.

Given the set of world prices, purchasing power GDP for country j is

$$GDP^j = P^w \cdot X^j.$$

Comment: A problem that I have not addressed is that not all prices are available. There are about 1600 prices, and, making the connection between Indian saris and pant suits is not easy and involves a considerable amount of judgment. In fact, there are typically only 1100 prices for rich countries and 600 or 700 for poor countries. Summers has a regression procedure to fill in missing prices. These studies are not carried out every year. In my research, I eliminate countries that never have been bench marked (that is prices have never been collected). This eliminates half the countries in the world. The eliminated countries tend to have small population and to be poor.