

# A Square Relationship between Relative Income and Price levels among Countries

Yuichiro Yoshida\*

July 2003

## 1. Introduction

When I traveled to Korea from Japan, I found that a bowl of soup costs about half as much as in Japan. When I traveled to Myanmar, it was just one tenth of Japan. At the same time, average (per-capita) income in Korea is roughly a quarter of that in Japan, and for Myanmar, it is just a percent of Japan. Obviously, a quarter is one half squared, and a tenth is a square of a percent. This suggests the existence of a very simple, but strong relationship between price and income. That is, if the price level in Korea is half as much as that of Japan, then Korea's per-capita income is one quarter of that of Japan; and if Myanmar's price level is a one-tenth of that of Japan, then Myanmar's per-capita income relative to that of Japan is just one-hundredth.

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\*Graduate School of International Relations, International University of Japan; Yamato-machi, Minami Unuma-gun, Niigata-ken, Japan 949-7277, e-mail: yoshida@iuj.ac.jp.

Based upon this simple observation, this paper indeed reveals a robust relationship between the relative price and income levels among countries in the world such that a country's per-capita income relative to another is a square of the ratio of their price levels.

## 2. The Model

Let us define  $Y_i$  and  $P_i$  as per-capita income and price level of country  $i$  respectively.

Then proposed relationship is

$$\frac{Y_i}{Y_j} = \left( \frac{P_i}{P_j} \right)^2.$$

By taking log, the above equation becomes

$$\ln Y_i = a + 2 \ln P_i$$

where

$$a = \ln Y_j - 2 \ln P_j$$

and country  $j$  is the benchmark country.

Thus in order to test the above relationship, the following linear equation is estimated:

$$\ln Y_i = a + b \ln P_i.$$

Then we examine if the slope coefficient  $b$  is indeed 2.

### 3. Data and Results

Cross-sectional (cross-country) data at several different time points are used to estimate the above equation for each year separately. Income variable  $Y_i$  is represented by per-capita income in US dollars. Price level  $P_i$  is computed as the ratio between PPP and the exchange rate.<sup>1</sup>

Table 1 summarizes the results. All the coefficient estimates are indeed very close to 2, and the 95% confidence interval contains 2 for all the years. Even though our analysis uses the cross-sectional data, the  $R^2$  are very high being around or above 0.7 for all years.

### 4. Conclusions

The relationship presented here in this paper is very clear and distinct. Income level of a country relative to another is a square of the relative price between the two countries. Of course, it is natural to assume a common underlying factor (or mechanism) that affects both the relative price and relative income simultaneously, rather than assuming a direct causality between them. In other words, any theory which involves price and income now has to be consistent with this robust fact that they are in the square relationship. This is a very strict constraint in constructing a fundamental economic theory, which in turn means that the found relationship provides significant information in doing this essential task of Economics.

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<sup>1</sup>Exchange rate data are from IFS of the IMF and all other data are from WDI of the World Bank.

**Table 1:** Estimation Results

Year	Coefficient	Standard Deviation	95% Confidence Interval		Number of Observations	Adjusted R-Squared
2001	2.054	0.151	1.745	2.363	30*	0.864
2000	2.119	0.117	1.889	2.350	141	0.701
1999	2.179	0.116	1.950	2.408	140	0.718
1998	2.133	0.120	1.896	2.371	139	0.696
1997	2.214	0.121	1.976	2.452	141	0.706
1996	2.154	0.119	1.920	2.389	141	0.702
1995	2.139	0.110	1.921	2.358	140	0.730

\* OECD only.