Breaking the Prebish Singer Hypothesis using Panel Data Stationarity Tests

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Abstract

In this paper, we test the Prebish-Singer (PS) hypothesis which states that real commodity prices decline in the long run, using two recent powerful panel data stationarity tests accounting for cross sectional dependence and a structural break. We find that the hypothesis cannot be rejected for most commodities but oil.

JEL classification: C12, C33, N50, O13, Q32.

Key words: Panel data; stationarity tests; cross-sectional dependence; terms of trade, commodity prices, Prebish-Singer hypothesis, structural break.

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1 Introduction

This paper investigates the empirical validity of the so-called Prebish-Singer (PS) hypothesis. We recall that the PS hypothesis (see Hadri 2011 for more references) states that real commodity prices follow a downward secular trend. Prebish (1950) and Singer (1950) claimed that there had been a downward long-term trend in these prices and that this decline in these prices is likely to carry on. The consequences of this hypothesis are very important for developing countries because many of them depend on only few primary commodities to generate most of their export earnings. This overwhelming reliance on commodities has serious policy consequences. In case of actual long-run downward trend of the exported commodities, the concerned country might have to explore diversification of its export portfolio to include manufactures and services.

2 Literature review

The first empirical studies revealing a downward real price assumed that y_t ,the real commodity price, is generated by a stationary process around a time trend ($I(0)$):

$$y_t = \beta_0 + \beta_1 t + \varepsilon_t, \ t = 1, \ldots, T, \tag{1}$$

where t is a linear trend and the random variable ε_t is stationary with mean 0 and variance σ_ε^2. The parameter of interest is the slope β_1, which is predicted negative under the PS hypothesis. Grilli and Yang (1988), inter alia, employing a data set of 24 annual commodity prices found that a weighted aggregate index dropped by 0.6% per annum. Other researchers assumed that commodity prices were generated by a so called difference-stationary (DS or $I(1)$) model, implying that y_t is non-stationary:

$$\Delta y_t = \beta_1 + v_t, \ t = 1, \ldots, T, \tag{2}$$

where v_t is stationary and invertible. Some empirical studies employing equation (2)

show evidence against the PS hypothesis. In particular, Kim et al. (2003) found that relative commodity prices behave like unit root processes (nonstationary process) and only five commodity prices amongst the 25 commodity prices included in the Grilli-Wang index exhibit the negative trend predicted by the PS hypothesis. It is well known, now, that if y_t is a DS process, then using equation (1) to test the null hypothesis: $\beta_1 = 0$ will result in acute size distortions, leading to a wrong rejection of the null when no trend is present, even asymptotically. Alternatively, if the true generating process is given by equation (1) and we base our test on equation (2). Our test becomes inefficient and less powerful than the one based on the correct equation. Therefore, when testing the PS hypothesis we have first to test the order of integration of our relative commodity prices in order to use the right equation. The problem might be compounded by the presence of structural breaks in equation(1) or (2). In this case, the true generating process may be a trend stationary process with breaks:

$$y_t = \beta_0 + \beta_1 t + \delta DU_t(\omega^*) + \gamma DT_t(\omega^*) + \varepsilon_t, \ t = 1, \ldots, T, \tag{3}$$

or, alternatively, a difference stationary with breaks:

$$\Delta y_t = \beta_1 t + \delta D_t(\omega^*) + \gamma DT_t(\omega^*) + \Delta \varepsilon_t, \ t = 2, \ldots, T, \tag{4}$$

where $DT_t(\omega^*) = t - T^*$ when $t > T^*$ and 0 otherwise, $DU_t(\omega^*) = 1$ if $t > T^*$ and 0 otherwise, and $D_t(\omega^*) = 1$ when $t = T^* + 1$ and 0 otherwise, with $T^* = [\omega^* T]$ the break date with the associated break fraction $\omega^* \in (0, 1)$ and [.] denotes the integer part of the argument. As shown by Perron (1989), the properties of tests for the presence of a break in trend are also highly dependent on the order of integration of the series concerned.

To increase the power of these tests we may use panel unit-root and/or stationarity tests which are well known to be more powerful than their single time series counter-part. The knowledge that commodity prices are stationary (mean reverting) or non-stationary is crucial for the design of economic policy. In the case where commodity prices are mean

reverting any shock will have only a transitory effect. Whereas if commodity prices are nonstationarity, shocks imprint a permanent effect on those prices.

3 Data and results

3.1 Data

The annual data set used covers the period 1960-2007. We employed 9 primary commodity prices relative to the US CPI index (zinc, tin, oil, wool, iron, aluminium, beef coffee and cocoa). The summary statistics and graphs of our data can be provided by the authors on request.

3.2 Testing whether the series are mean reverting using panel data stationarity tests

It is well known that univariate time series tests for unit root and stationarity have very low power. It has been shown through simulations that panel data tests for unit root and stationarity are far more powerful than their univariate counterpart (see Baltagi (2008) for a review of this literature). In this paper, we shall use two recent panel stationarity tests proposed by Hadri and Rao (2008) and Hadri and Kurozumi (2012) respectively. The later has been extended here to allow for a break in the intercept or the trend or in both like in Hadri and Rao (2008). Since the pioneering work of Perron (1989) which illustrates the need to allow for a structural break when testing for a unit root in economic time series, the problem of structural breaks in the level/slope of a series has proved to be of considerable interest in the unit root testing literature. Perron (1989) has found that unit root tests are biased toward accepting the false unit root null hypothesis in the presence of a structural break. It is widely accepted that the failure of taking into account structural breaks is likely to lead to a significant loss of power in unit root tests. Similarly, stationarity tests ignoring the existence of breaks diverge and thus are biased toward rejecting the null hypothesis of stationarity in favour of the false alternative of a unit root hypothesis. This is due to

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severe size distortion caused by the presence of breaks (see *inter alia* Lee *et al.* (1997)). Kurozumi (2002), Lee and Strazicich (2001) and Busetti and Harvey (2001, 2003) have considered testing the null hypothesis of stationarity in the presence of a single break versus the alternative of a unit root in time series. The selection of the appropriate break model for each price series, amongst the four possible ones, is data driven. Any serial correlation is mopped out. It also correct for the very likely presence of cross-sectional dependence for the first test via the bootstrapping method and for the second test, using the method proposed in Pesaran (2007) to mop-up the effect of a cross-sectional dependence in the form of a common factor in the disturbance. It has been shown by, inter alia, O'Connell (1998) and Strauss and Yigit (2003) that the size of the test in the presence of unaccounted cross sectional correlation is considerably distorted. We calculated the pairwise correlation coefficients across prices (these coefficients may be provided by the authors upon request). There are positive and significant between real commodity prices except with oil price series where the coefficients are relatively small some negative but all insignificant (at 5% significance level). Pindyck and Rotemberg (1990) noted this strong correlation in the prices of unrelated commodities which they called "Excess co-movement". They found that even after controlling for current and expected future values of macroeconomic variables this excess co-movement remains.

By using panel we are able to account for this cross sectional dependence. We are in a position to test jointly the null hypothesis that *all* the commodity prices are stationary ($I(0)$) against the alternative that some of them are nonstationary or unit root processes ($I(1)$). The results of the first test are given in Table 1.

Table 1. Panel Stationary test Results (Hadri and Rao (2008))

	N	T	statistic value	Bootstrap critical values	
				10%	5%
Using tsig criterion	9	48	3.913	11.164	12.617
Using BIC criterion	9	48	2.647	7.824	8.975

The null hypothesis that all the commodity prices are stationary is not rejected indicating that all the commodity prices are mean reverting (the two criteria used are for the correction

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for possible serial correlation, see Hadri and Rao (2008) for more explanations). This is an important result. It means that shocks have only temporary effect on real commodity prices. The fact that the 9 commodity prices are stationary will permit us to use classical econometrics tools to test the PB hypothesis. The latter test is given in Table 2.

3.3 Testing whether the series have downward trends

All commodities without a break have a significant negative trend except oil which is positive but not significant, as shown in Table 2. The ones with a break have a significant negative trend before the break and a positive but insignificant trend after the break. The estimations after the break are not reliable because of the size of the sample (only 5 observations).

Table 2.One Sided Test for a Negative Trend. Pvalue inside brackets

	Growth Rate(%) (no break)	before break	after break.
Zinc		-0.0087 (.0055)	0.35078 (0.993)
Tin		-0.033 (0.000)	0.1905 (0.97)
Oil	0.0214 (1)		
Wool	-0.0205 (0.000)		
Iron		-0.0184 (0.000)	0.2339 (0.994)
Aluminium	-0.16 (0.000)		
Beef	-0.024 (0.000)		
Coffee	-0.294 (0.000)		
Cocoa	-0.0254 (0.000)		

The result of the tests employing Hadri and Kurozumi (2012), recently published in this journal, accounting for cross section dependence à la Pesaran and extended to allow for a structural break are given in Table 3.

Table 3. Hadri Kurozumi (2012) Panel Stationary test extended to account for a structural break

	N	T	statistic value[3]
Using Sul, Phillips and Choi (2005) long run variance estimator	9	48	-2.0497

The null hypothesis that all the commodity prices are stationary is again not rejected in Table 3, at all the usual levels of significance, indicating that all the commodity prices are stationary. This is reinforcing the previous result. It means that shocks have only temporary effects on real commodity prices although, these effects might be very persistent as shown, inter alia, by Cuddington and Jerret (2008). We also obtain the same results as the ones reported in Table 2 with all real commodity prices having a significant negative growth except oil which is positive but insignificant.

6. Conclusion

We tested the PS hypothesis employing two recent panel stationary tests, accounting for cross sectional dependence and a structural break, to test for the stationarity of 9 real commodity prices and found that in both tests, the hypothesis is true for the 9 real commodity prices.

We found that all the 9 commodities included in our sample are mean reverting (stationary) via panel stationary test. All the 9 real commodity prices have a significant negative growth rate except oil which is positive but not significant. We also discovered that the 9 commodities are pairwise positively and significantly correlated except with the real price of oil. The correlations between oil and the rest are not significantly correlated.

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[3]Reject null hypothesis when the statistic is greater than 1.645

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