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The Prebish-Singer hypothesis in the post-colonial era: evidence from panel cointegration

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Abstract

We test the Prebish-Singer hypothesis that commodity prices tend to decline relatively to manufactured goods prices using a panel cointegration bootstrap test, for the period 1950-2011. We find partial support for the hypothesis, which appears to hold for Food and Non Food agricultural products but not for Metal goods.

Keywords: Prebish-Singer hypothesis, commodity prices, panel cointegration, bootstrap.

JEL codes: C22, C33, O13, Q11

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1 Commodity and manufactured goods prices in the long-run

The purpose of this paper is to revisit the Prebish-Singer hypothesis (PSH; Prebish 1950, Singer 1950; for a review Baffes and Etienne, 2016) of a secular decline of the ratio between between the prices of primary commodities (p^c) and manufactured goods (p^m). Possible causes include differentials in the elasticity of demand, stronger competition in commodity markets and excess supply of labour in countries producing commodities. Since commodities are a large fraction of a export earnings of least developed countries (on the average currently about 70%, but nearly 100% in Western and Middle Africa; UNCTAD, 2017) this issue has paramount policy relevance. Empirical tests abound, but tend to be distinctivly unconclusive: according to Baffes and Etienne (2016) about half of the post-1980 studies support PSH, while the other half reject it. Most of the tests are univariate analyses of the time series properties of the ratio p^c/p^m, possibly allowing for breaks (*e.g.*, Arezki *et al.*, 2012), with a less developed stream of the literature devoted to estimating the p^c-p^m relationship. Assuming non-stationarity of both price series, if cointegration holds the equation $p_t^c = \beta p_t^m + e_t$ is a long-run equilibrium relationship and the (log) real commodity price can be written as $(p_t^c - p_t^m) = (\beta - 1)p_t^m + e_t$, where e_t is a stationary deviation from equilibrium. If $\beta = 1$ then $(p_t^c - p_t^m) = e_t$: the real commodity price is stationary and the PSH does not hold. If on the contrary $\beta < 1$ the non-stationary part dominates and the real commodity price follows a downward trend, consistently with PSH. Following this approach Von Hagen (1989) rejected PSH for three commodity price indeces (Food, Non Food agricultural products and Metals products) for the period 1900-1986, but excluding a number of outliers. More recently, Mariscal and Powell (2014) reached a similar conclusion for the period 1900-2010, but point out that all parameter shifts allowed point in the direction of falling terms of trade.

The conclusions of these two papers highlight a major difficulty of any empirical test of the PSH, namely the impact and treatment of structural breaks. Although these can be endogenously estimated, to be credible estimated break dates need to be supported by precisely identified historical events. This is not always an easy task. Second, although there is general agreement that their number should be small, what this may mean in practice is open to dispute. A completely different strategy would be to deliberately ignore breaks, and achieve robustness by appropriate choices of study period, data and methods. Following this approach, we will contribute to the debate examining by means of bootstrap panel cointegration tests the p^c-p^m relationship using a subsample of the widely employed extended Grilli-Yang dataset (Pfaffenzeller, 2013) for three commodity price indeces, Metals (copper, aluminium, tin, silver, lead, and zinc), Non Food (cotton, jute, wool, hides, tobacco, rubber, and timber), and Food (coffee, cocoa, tea, rice, wheat, maize, sugar, lamb, beef, bananas, and palm oil) agricultural products. We try to achieve robustness in three different ways. First, we restrict the study to the post-WWII period, 1950-2011: excluding the two world wars and the Great Depression will limit substantially the number of potential breaks[1]. Second, we study aggregate indeces, so that breaks affecting individual goods will be smoothed out. Finally, we use a bootstrap panel cointegration test, which will grant power even with a limited time sample.

2 Data description

Price dynamics is measured for manufactured goods by the Manufacturing Unit Value (MUV) arithmetic trade-weighted index of the goods exported to developing countries by the five largest developed economies (France, Germany, Japan, United Kingdom, and USA), and for commodity prices by indeces with either arithmetic and geometric aggregation[2]. Both aggregation schemes deserve to be considered, although for different reasons. On one hand, arithmetic indeces are the most widely used in the literature. On the other, models with aggregate geometric indeces as dependent variables can be theoretically justified as the result of linear aggregation of log-linear relationships between individual commodity prices and MUV, while those using arithmetic indeces are not easily related to the individual relationships. Finally, Cuddington and Wei (1992) showed that results are not always robust to with respect to the type of aggregation.

[1]In fact, this period is interesting for its own sake. First, the end of the colonial era in the 1950's defined a world political scenario very different from that of the first half of the 20th century. Second, in this period world GDP growth, and thus commodity trade, has been much faster than before (average GDP growth 1950-2010: 2.21% per year, nearly three times the 1900-1913 value, 0.84%; source: The Maddison-Project).

[2]Respectively, $I_t = \sum \theta_i P_{it}$ and $I = \sum P_i^{\theta_i}$, where θ_i is commodity i average export share and P_i its price.

From Table 1 and Fig. 1 it is evident that both type of indeces for all the three baskets tracked extremely closely that of manufactured goods until about 1980, lost considerable ground over the 1980's and 1990's, and regained it during the price boom of the early 2000's. The last two decades of the 20th century essentially appear as prolonged deviatons from equilibrium, fully absorbed in all cases by the end of the first decade of the following century. Over the entire period growth has been definitely slower for Food and Non Food agricultural commodities than for Metal goods: respectively, around 3% and slightly above 4%, with that of Manufactured goods prices standing in between, at slightly above 3%. In all cases the evident non-stationarity is confirmed by univariate and panel unit root tests (see Table 2).

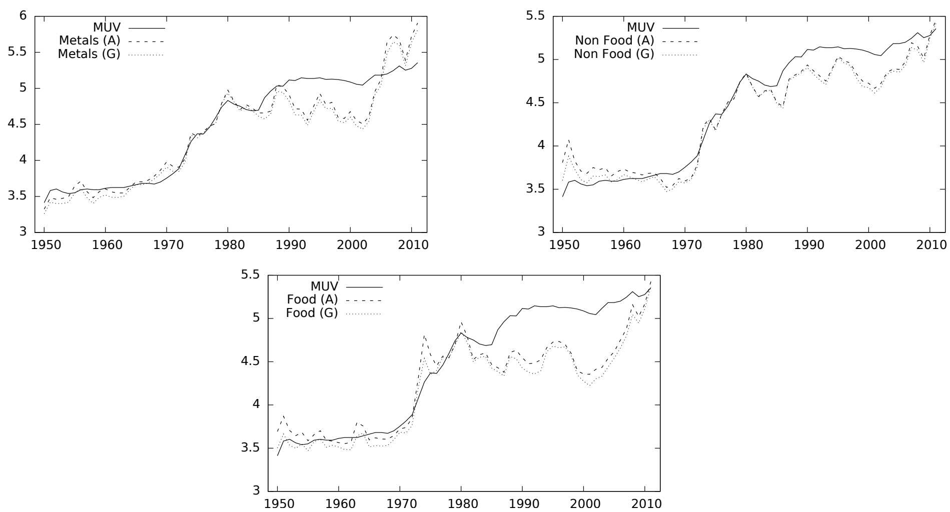

Figure 1: left to right: logs of MUV and commodity price indeces, 1950-2011 (A: arithmetic index, G: geometric index)

Table 1: MUV and commodity prices, mean growth rates($\times 100$)

		Arithmetic Indeces			Geometric Indeces		
	MUV	*Metal*	*Non Food*	*Food*	*Metal*	*Non Food*	*Food*
1950-1980	4.85	5.66	3.50	4.33	5.74	4.18	4.59
1981-2000	2.15	1.60	1.04	-0.92	1.21	0.88	-0.97
2001-2011	3.04	14.47	8.22	11.34	14.25	8.39	12.11
1950-2011	*3.24*	*4.32*	*2.74*	*2.89*	*4.27*	*3.02*	*3.10*

Source: elaborations on extended Grilli-Yang data (Pfaffenzeller, 2013).

Table 2: Time Series properties of MUV and Commodity Prices (logs), 1950-2011

		Arithmetic Indeces			Geometric Indeces		
	MUV	*Metal*	*Non Food*	*Food*	*Metal*	*Non Food*	*Food*
ADF-GLS	-1.69	-2.04	-1.60	-1.81	-1.89	-1.71	-1.66
F-test			2.71 (42.6)			2.34 (35.4)	

ADF-GLS: with trend, 10% critical value: -2.74.
F-test: Chang (2004) Panel unit root test, p-value$\times 100$ in brackets (5000 redrawings).

3 Estimation and testing

As a first step we tested for cointegration between the each of three commodity price indeces and MUV using standard Engle-Granger tests, finding no evidence of a stable relationship[3]. This is somehow at odds with the graphical evidence: while at the end of the 20th century MUV drifted away from all commodity price indeces, it is also true that in all cases in the following decade there has been a clear tendency to restore equilibrium. The problem is that the similarity of the three paths is ignored by individual tests, and in each case the disequilibrium spell is long enough to produce the individual results of no cointegration. We clearly need a panel procedure testing the null hypothesis "*no* commodity price index is cointegrated with

[3] Details available on request.

MUV" against the alternative hypothesis "*all* commodity price indeces are cointegrated with MUV". Panel cointegration tests based on the average of the individual statistics are not suitable, as a given average may be obtained from either a panel of all moderately cointegrated sets of variables and one in which only a minority are, but strongly so. To ensure rejection of no cointegration if, and only if, *all* relations in the panel are cointegrating we need to look at the maximum of the individual statistics. Applying this principle Di Iorio and Fachin (2014) developed a bootstrap test, *Max(HEG),* which is robust to short- and long-run dependence across the units of the panel and is thus suitable for our needs. From Table 3 we see that using a 5% significance level the test generally suggests cointegration, somehow marginally for the geometric indeces but safely for arithmetic indeces (bootstrap p-values respectively 5.4% and 3.6%).

Having established cointegration we estimate the p^c/p^melasticity by FM-OLS. From Table 4 we can see that the point estimates are always smaller than 1, thus supporting PSH, although for Metal goods both values are over 0.90 and the standard errors quite large. Since PSH is a composite hypothesis, we tested it as the alternative hypothesis against the proportionality hypothesis $H_0 : \beta = 1$. To ensure robustness we used both standard asymptotic and bootstrap p-values. As expected, proportionality is never rejected, thus PSH rejected, for Metal commodities. On the other hand, PSH seems to hold for both aggregate indeces of agricultural prices, Food and Non Food alike (although for the former the conclusion is somehow less clear cut).

Our general conclusion is that the Prebish-Singer prediction finds partial support from the post-WWII data. In the long-run, over this period producers of metal commodities have been able to keep approximately intact their purchasing power in terms of manufactured goods, while those of all agricultural commodities did not. These findings are remarkably consistent with those by Chakraborty (2016), reached following a completely different approach (univariate analysis allowing for breaks).

Table 3: Panel cointegration test, 1950-2011 (logs)

	Arithmetic Indeces	*Geometric Indeces*
Max(HEG)	-0.96 (3.6)	-0.90 (5.4)

H_0 : "no commodity price index is cointegrated with MUV"
H_1 : "all commodity price indeces are cointegrated with MUV";
bootstrap p-value×100 in brackets (5000 redrawings).

Table 4: The $p^c - p^m$ relationship (logs), 1950-2011

	Arithmetic Indeces			Geometric Indeces		
	Metal	*Non Food*	*Food*	*Metal*	*Non Food*	*Food*
β	0.93	0.82	0.67	0.92	0.85	0.70
(s.e.)	(0.23)	(0.05)	(0.12)	(0.23)	(0.05)	(0.15)
p	37.6	0.03	4.2	36.1	0.2	2.4
PSH	no	yes	(yes)	no	yes	yes
p^*	38.6	0.4	2.0	35.9	0.9	5.0
PSH	no	yes	yes	no	yes	(yes)

Model: $p_t^c = \beta p_t^m + e_t$; *Tests*: $H_0 : \beta = 1$ vs $H_1 : \beta < 1$;
p : asymptotic p-value×100, t distribution; p^*: bootstrap p-value×100 (Stationary Bootstrap, 5000 redrawings);
PSH : at the 5% significance level: "no", rejected; "yes", not rejected; (yes), marginally not rejected.

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