The Appropriate Parity Exchange Rate to be Used in Valuing Land Reform Bonds in Peru

By Alan Heston[1]

I have been asked to opine on the issue of parity exchange rate, and to determine what is the appropriate way to calculate that parity exchange rate if one were to make use of that concept to update the value of the debt associated with Peru's land reform. I understand that this report will be submitted before Peru's Constitutional Tribunal to assist that Tribunal in the adjudication of certain issues put before it. I have no interest in the outcome of any such proceedings.

In January 2014 Peru's Ministry of Economy and Finance ("MEF") published the formulas for calculating the redemption value of land reform bonds that were issued beginning in 1969.[2] The formulas purport to convert the original face value of the bonds, denominated in Soles Oro, Peru's currency at the time, into U.S. dollars using a parity exchange rate. The resulting dollar amount then accumulates interest, and finally is converted back into Nuevos Soles at the 2013 annual average market exchange rate.

The use of a parity exchange rate in the first step purports to follow guidelines issued by Peru's Constitutional Tribunal ("TC") in July 2013.[3] The TC, however, did not provide specific indication of how a parity exchange rate is to be determined. The MEF's formulas suffer from serious flaws, which I understand Drs. Iván Alonso and Italo Muñoz address in a separate report. In this report, I describe what in my professional opinion is the proper way to calculate the purchasing power parity ("PPP") exchange rate if such a rate is to be used to convert into U.S. dollars the value of land reform bonds denominated in Peruvian Soles that were issued by the Government of Peru starting in 1969.

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[2] Supreme Decree No. 017-22014-EF of January 18, 2014 and Supreme Decree No. 019-2014-EF of January 22, 2014 issued by the Ministry of Economy and Finance (collectively the "Supreme Decree").

[3] Constitutional Tribunal's Ruling of July 16, 2013 issued in file N° 00022-1996-PI/TC, ¶ 24-25.

I Parity Exchange Rate Definition and Background

The TC stated that the land reform debt should be converted into U.S. dollars at parity exchange rates. A parity exchange rate is what is referred to as a PPP converted exchange rate. (Deaton and Heston, 2010). The concept of Purchasing Power Parity or PPP is due to Gustav Cassel almost a century ago. Cassel was concerned with how to set the Swedish Kroner's value in terms of gold after the disruptions of WWI, when the Kroner and other currencies were not convertible. He says:

> "I propose to call this parity "*the purchasing power parity*[1]. As long as anything like free movement of merchandise and a somewhat comprehensive trade between two countries take place, the actual rate of exchange cannot deviate very much from this purchasing power parity." Gustav Cassel (1918, p. 413).

This became known as the Purchasing Parity Doctrine and was a major contribution to the understanding of the international economy at the time. It strongly supported the notion of a world where prices would tend to converge to one common level, as transport costs and other obstacles to trade declined both within and between countries. The law of one price, an implication of Cassel's doctrine, became a powerful anchor to a variety of theories. This absolute version of the doctrine gave way to a relative version as capital movements, for speculative or other reasons, have dwarfed the value of imports and exports of goods and services. A derivative proposition (called relative PPP) is that changes in the exchange rate over time should reflect the cumulative difference in foreign and local inflation.

The relative version of Cassel is consistent with prices of goods and services in different countries being different when they are converted at nominal exchange rates to, say, the US$. The parity exchange rate to the US for Peru would be the value in Soles of an average bundle of goods and services at Peru prices divided by value in dollars of the same bundle in US prices. Put another way, the parity or PPP converted exchange rate is that rate which converts the foreign price (say, in U.S. dollars) for the average bundle of goods when purchased in the foreign market (here, the U.S.) into the number of units of local currency (say, Peruvian Soles) for which one can buy the same average bundle of goods in the local market (here, Peru). The resulting PPP

over GDP is expressed in Soles per Dollar. An average bundle involves all the countries in a multilateral comparison conducted in a program styled the International Comparison Program. (“ICP”) This multilateral comparison includes 60 countries in 1980, 65 in 1985, 120 in 1996 and 146 in 2005. We include 2005 because the 1996 ICP was carried out at different times in the regions over the period 1993 and 1996 and it is widely thought to be less robust than other ICPs. ICP 2005 was a major improvement over both 1985 and 1996 in my view.

Actual nominal exchange rates may deviate from their PPP values either temporarily or for long periods. Temporary deviations usually occur during periods of high inflation, other monetary disturbances, or windfall changes in the terms of trade. Permanent deviations may arise from transport costs or import tariffs, as a result of which the foreign and local prices of any single good, let alone a basket of goods, are not necessarily the same when expressed in the same currency. As discussed in more detail below, permanent deviations may also arise from differences in worker productivity, which are often related to differences in countries' relative wealth in a manner that tends to depress the PPPs of poorer countries relative to their nominal exchange rates.

II Price Levels

The PPP is often expressed in price level form as in (1) below, where PL is the price level and XR is the nominal exchange rate.

(1) $PL = 100*PPP/XR$

The reason that the price level is a useful concept can be illustrated with respect to Peru. The consumer price index (“CPI”) in Peru has shown wide swings in the last 60 years, but so has the nominal exchange rate and they are highly correlated. In other words, as inflation – and sometimes hyperinflation – has caused Peru's CPI to increase at sometimes quite rapid rates, the nominal exchange rate has typically increased at similar rates, reflecting the fact that inflation results in more Nuevos Soles being needed to buy the same bundle of goods. Further, Peruvian inflation has often substantially outpaced U.S. inflation. But the price level of Peru has been fairly stable even while exchange rates and CPIs have displayed wide swings over the period 1950 to 2013 compared to the reference country, the US. Peru's price level has varied within

the range of about 30% to 60% during the period from 1969 to 1999 – which is to say, Peru's nominal exchange rate has generally been 2 to 3 times higher than the rate needed to provide parity. This pattern of relatively stable price levels compared to wide swings in CPI has been similar in Argentina and Brazil, while across other ICP regions, including Africa and Asia, the swings in CPI have been less.

According to the ICP, the Price Level varies from under 30% to 180%, with most high price level countries also being high income countries. That is, the PPPs in poorer countries are usually systematically below their nominal exchange rates. Balassa (1964) and Samuelson (1964) offered an explanation for this based upon differences in worker productivity (Summers, Heston and Nuxoll, 1994). The price of a tradable good like rice will tend to be the same around the world for exporters (but higher for importers because of transport costs). Non-tradable goods like roads and non-tradable services like restaurant meals, however, exhibit very different prices around the world. These differences arise because of variations in the productivity of workers with respect to tradable goods. Because the prices of tradable goods tend to be the same around the world, workers making tradable goods in countries with lower worker productivity generally receive lower wages than workers making tradable goods in countries with higher worker productivity. To illustrate this point, rice growers in India are less productive and are thus paid less than rice growers in the U.S. Because national labor markets are usually competitive, the earnings of workers such as rice growers making tradable goods will tend to determine the wages of workers of comparable skill making non-tradable goods and services. So in countries with low productivity per worker, the relative prices of non-tradable goods tend to be lower than in countries with high productivity per worker. The opposite is true in countries like the US with high productivity per worker in rice farming and many other tradable goods.

The overall price level of a country is the average of the tradable and non-tradable price levels where the weight is about equal across countries. Since poorer countries have relatively low and richer countries relatively high non-tradable prices, overall price levels usually rise with per capita income.

III The International Comparison Program

In 1968 the United Nations Statistical Office launched the ICP for the purpose of conducting detailed price comparisons across a variety of countries to obtain the building blocks necessary to estimate PPPs. Prior to that time there was no reliable way to calculate PPPs or estimate the relative purchasing power of different currencies with any accuracy. Working through the United Nations Statistical Office, my colleagues at the University of Pennsylvania, Irving Kravis and Robert Summers, and I coordinated detailed price comparisons in 10 countries to produce the first ICP benchmark report of PPPs in those countries for 1970. The scope of the ICP has since grown to include 191 countries in 2011. The Penn ICP group published three additional benchmark reports covering 10, 16 and 34 countries in 1975, 1978 and 1982, respectively. After 1970, the ICP has been organized and coordinated throughout the world by the United Nations and World Bank. I served at the United Nations for nearly 3 years during the transition. Robert Summers and I also developed and updated extensions of the ICP known as Penn World Tables ("PWT") that are widely viewed and relied upon as authoritative estimates of PPPs for the countries and years covered and for which we were designated Distinguished Fellows of the American Economic Association in 1998.

The method used in the ICP benchmark reports classifies 600 to 2000 item prices submitted from each country into about 150 basic headings making up GDP. A basic heading is the lowest level of detail for which countries provide expenditures. For a heading like fresh vegetables there may be 20 detailed specifications, for which countries may average 5 prices. The CPD regression (Country Product Dummy) makes use of all prices submitted to estimate for each country a basic heading parity for fresh vegetables and other basic headings. These basic heading parities are then aggregated using expenditures as weights into aggregate PPPs for GDP and other major components of expenditures.

IV Parity Exchange Rate Estimation

The initial ICP produced PPPs for only 10 countries for 1970, Colombia being the only Latin American participant. Subsequent ICP rounds were 1975,

1980, 1985, 1996, 2005 and 2011. Peru began participation in 1980 and has taken part in all subsequent rounds.

Because the ICP PPP estimates are only at intervals, it is necessary to interpolate to obtain annual PPPs. Updating PPPs is often done at the aggregate level using the relative GDP deflators to estimate the PPP in years for which benchmark ICP studies are not available.

Table 1 shows my estimate of the parity exchange rates for Peru relative to the U.S. for 1969 through 1999 in column 3. The approach in Table 1 takes account of all of the available ICP benchmarks. The underlying starting point is the 4 ICP estimates for Peru: 1980, 1985, 1996 and 2005.[4] A smoothing process is used to obtain annual estimates in all of the years from each of the ICP benchmarks based on the national accounts deflators for consumption, investment and government investment.[5] An average of these estimates is then taken, with each estimate weighted so that ICP benchmarks closer to the year of interest are given greater weight.

[4] The 2005 ICP is beyond the period of estimation. The reason that I have included 2005 is that there were some deficiencies in the 1996 ICP. The regions participating in the 1996 benchmark carried out their comparisons at different times over the 1993 to 1996 reference periods. It proved difficult to link the regions. Since the 2005 ICP was the largest and best funded ICP until that time, I believe it improves the estimation for Peru to include the 2005 estimates.

[5] This smoothing process is described in the documentation for Penn World Table 7.1. The method uses the deflators for the three main components of GDP -- consumption, government and investment -- and moves them forward and backward to obtain values for other years for each component. The components are then added up to obtain the total of Domestic Absorption. The net foreign balance is then added to obtain the overall GDP price level and production. PWT7.1 is available at pwt.sas.upenn.edu/php_site/pwt_index.php.

Table 1

**Estimates of Annual Parity Exchange Rates
Based on ICP Benchmark Comparisons**

	Currency Unit	Nominal Exchange Rate	Parity Exchange Rate
Year	**1**	**2**	**3**
1969	Sol Oro	38.70	14.00
1970	Sol Oro	38.70	15.00
1971	Sol Oro	38.70	15.50
1972	Sol Oro	38.70	16.30
1973	Sol Oro	38.70	16.80
1974	Sol Oro	38.70	17.50
1975	Sol Oro	40.40	20.60
1976	Sol Oro	55.80	25.30
1977	Sol Oro	84.20	32.60
1978	Sol Oro	156.30	48.30
1979	Sol Oro	224.70	71.20
1980	Sol Oro	288.90	108.10
1981	Sol Oro	422.30	172.90
1982	Sol Oro	697.60	276.60
1983	Sol Oro	1,628.60	557.20
1984	Sol Oro	3,466.90	1,152.60
1985	Inti	10.9749	3.048
1986	Inti	13.9475	5.1503
1987	Inti	16.8358	8.9157
1988	Inti	128.8317	60.3067
1989	Inti	2,666.1875	1,671.9488
1990	Inti	187,885.5792	92,644.3474
1991	Inti	772,500,000,00	418,732.2306
1992	Nuevo Sol	1.2458333333	0.6922925369
1993	Nuevo Sol	1.9883189167	1.0075376212
1994	Nuevo Sol	2.1950000000	1.2320982226
1995	Nuevo Sol	2.2533333333	1.3559204060
1996	Nuevo Sol	2.4533333333	1.4839636677
1997	Nuevo Sol	2.6641666667	1.5646207829
1998	Nuevo Sol	2.9300000000	1.6762320957
1999	Nuevo Sol	3.3833333333	1.7385869663

Parity Exchange Rate is taken from PWT 7.1.

V Conclusion

For the reasons set forth above, I believe the parity exchange rates presented in column 3 of Table 1 provide the best estimates of the parity exchange rates for converting the value of land reform bonds denominated in Peruvian Soles into U.S. dollars. In contrast, I do not believe that the methodology set forth in the Supreme Decree is appropriate to estimate such parity exchange rate.

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Annex A

Resume of ALAN W. HESTON
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1. Education:

B.A.	University of Oregon	1955
M.A.	University of Washington	1957
Ph.D.	Yale University	1962

2. Professional Positions:

A. Regular Appointments

Professor, University of Pennsylvania, 1977 – 2003, Emeritus
Associate Professor, University of Pennsylvania, 1967-77
Assistant Professor, University of Pennsylvania, 1962-67
Assistant Professor, Yale University, 1961-62

B. Other Appointments

Visiting Lecturer Department of Economics, Univ. of Bombay, 1960-61
Senior Statistician, United Nations, 1978-79
Advisor, Pakistan Institute of Development Economics, 6/82 - I/83
Chief, International Price Statistics, United Nations, 1/83- 8/84
Visiting Professor, Northeastern University, Winter-Spring, 2000.

C. Other Positions

Secretary, Vice-President -Secretary-Treasurer, American Institute of Indian Studies, 197I-76
Consultant to World Bank on Price Studies,1981-present
Consultant to the UN Expert Group on the Reduction of Military Expenditures, 1984-85Budgets, 1/84 - 8/85
Member Council, International Association for Research on Income and Wealth, 1985-92
Chair, Council, International Association for Research Income and Wealth Wealth, 1987-89
Editor (1996- 2003), Annals of the American Academy of Political and Social Science. Academy of Political and Social Science
Member Technical Advisory Committee on the Cost of Living Allowance (COLA) of the Office of Personnel Administration, US Government, 1997-
Member of the Technical Advisory Group of the International Comparison Program, World Bank, 2003-

Co-Director, Center for International Comparisons of Production, Income and Prices, University of Pennsylvania, 1997-
Chair, Technical Advisory Committee, International Comparison Project, World Bank, 2004-2009.

3. Scholarly Affiliations:

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4. Fellowships and Research Support and Awards

Faculty Fellow, American Institute of Indian Studies for Field Work in India, 1965-66
Fulbright-Hays Faculty Award, India, 1970
Faculty Fellow, American Institute for Indian Studies 1981-82
United States Institute for Peace, 1987
U.S. Agency for International Development, 1988-90, 1992-93,and 1994
National Science Foundation,1986-88,1989-91,1992-5, 1996-2000, 2000-2004, 2003-2007, 2007-2010, 2010-2011, 2012-2015.
Distinguished Fellow, American Economic Association 1998

5. Publications:

A. Monographs:

A System of International Comparisons of Gross Product and Purchasing Power (with I.B. Kravis, Z. Kenessey, and R. Summers), Baltimore: Johns Hopkins University Press, May 1975. (XI, 294).

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B. Edited Volumes:

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C. Articles

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