

NUMBER PB10-8

APRIL 2010

## New PPP-Based Estimates of Renminbi Undervaluation and Policy Implications

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### INTRODUCTION

Is there reason to add to the proliferating set of estimates on the extent of renminbi undervaluation (see among others, Bergsten 2010; Cline and Williamson 2008 and 2010; Goldstein and Lardy 2008 and 2009; Frankel 2008; Reisen 2009; and Lee et al. 2008)? Yes, not least because these new estimates: (1) suggest that purchasing power parity (PPP)-based approaches to measuring renminbi undervaluation suggest that China's currency is undervalued by about 30 percent against the dollar and not the 12 percent recently reported (Bajaj 2010); and (2) are closer to and consistent with alternative approaches to estimating renminbi undervaluation.

Treasury Secretary Geithner has just announced that he will delay publication of the report to Congress on the international economic and exchange rate policies of the Chinese currency. He has decided to postpone until the summer the decision on whether he should brand China a currency manipulator. By the summer, a series of meetings will have

taken place, including a surprise one with Chinese leaders on April 8, a meeting of G-20 Finance Ministers and Central Bank Governors, the Strategic and Economic Dialogue with China in May, and the G-20 Finance Ministers and Leaders meetings in June 2010. Clearly, there have been some short-term understandings between the two countries but, until there is a significant and consistently upward move in the renminbi, the issue is unlikely to be fully resolved. Thus, the search for better estimates on currency misalignment needs to continue.

But there are also other substantive reasons for continuing this search. First, new data from the International Comparison Project (ICP) have become available that have been reflected in new estimates published in the World Development Indicators (WDI) by the World Bank in 2008 for GDP per capita adjusted for PPP. These estimates have attracted great controversy because of the large downward revisions in the living standards for China and India in particular. The controversy has been greatest in relation to measurements of world poverty necessitating new poverty estimates (see Chen and Ravallion 2008).

But the implications of this controversy have not been adequately recognized for PPP-based measurements of undervaluation of currencies. For example, on April 2, the *New York Times* (Bajaj 2010) reported, based on Reisen (2009), that PPP-based approaches yield an undervaluation of the Chinese currency of “only” 12 percent. As I show below: when the PPP approach is correctly applied, this figure turns out to be a serious underestimate.

Second, a new version of the Penn World Tables (PWT, version 6.3) has recently become available, which can also be used for reestimating PPP-based currency misalignment.

Finally, the need for redoing current estimates is called for in light of a new National Bureau of Economic Research (NBER) working paper (Johnson, Larson, Papageorgiou and Subramanian, 2009 [hereafter JLPS]). In that paper, we showed that there was a problem of valuation in the Penn World Tables that leads to considerable variability—across PWT versions and across time—in the estimates of PPP-based measures of income per capita and in the price level of GDP (which is the PWT's

variant of the real exchange rate). One implication is that it is not in general robust to use data from the PWT or the WDI for years other than the benchmark year for which detailed price data are collected; also, in general it is better to restrict data to countries for which detailed price data have been collected (benchmark countries). Hence, existing estimates of PPP-based undervaluation of the renminbi (Rodrik 2008 and Reisen 2009 among others) need to be redone.

**“In other words, as of this writing, PPP-based approaches to measuring China’s undervaluation suggest that the renminbi is undervalued by about 30 percent against the dollar and not the 12 percent recently reported.”**

The result of doing so yields a simple conclusion: In 2005 I find that the average estimate of renminbi undervaluation (against the US dollar) is about 30 percent; updating this estimate for end-March 2010, using the same methodology, leaves that estimate broadly unchanged at 30 percent. In other words, as of this writing, PPP-based approaches to measuring China’s undervaluation suggest that the renminbi is undervalued by about 30 percent against the dollar and not the 12 percent recently reported.

## BACKGROUND AND METHODOLOGY

Estimates of currency undervaluation and overvaluation are based on two broad categories of models. The first are macroeconomic models, using notions of external balance, savings and investment behavior, etc. to define an equilibrium exchange rate.<sup>1</sup> Limiting the current account or ensuring sustainable net external indebtedness are key variables in pinning down this equilibrium exchange rate. Departures from this equilibrium rate yield estimates of undervaluation and overvaluation. The latest estimates by Cline and Williamson (2010) and Goldstein and Lardy (2009) suggest renminbi undervaluation of between 15 and 30 percent against a basket

of currencies. It must be noted that these estimates are sensitive to projections for China’s current account surplus, which are being revised downward in response to the large actual decline in this surplus in 2009 and 2010 in the wake of the financial crisis.

A second basis for estimating currency disequilibrium stems from a longer, development perspective. The work of Balassa and Samuelson (hereafter BS) suggested that as countries grow over time, their real exchange rates should appreciate—reflecting productivity growth, particularly in the tradable goods sector. That is: As poor countries grow, the labor productivity of their traded-goods sector will tend to rise, spilling over to wages and prices in producing nontraded goods, and so their price structures should become more like those of developed countries. Thus a rising price—or an appreciating currency—is an equilibrium phenomenon.

Departures from this equilibrium relationship suggested by BS then provide the basis for calculating undervaluation and overvaluation of currencies.<sup>2</sup> In the Penn World Tables—whose *raison d’être* is the BS relationship—the real exchange rate (strictly speaking its inverse) is captured as the ratio of the purchasing power parity exchange rate to the market exchange rate. For example, in the case of India, the PPP exchange rate in 2005 was estimated at 14.7 rupees to the dollar compared with the market exchange rate of 44.1 rupees to the dollar. This yields a price level of GDP in India relative to the United States of 0.33 (14.7/44.1), suggesting that Indian prices are, on average, one-third of those in the United States.

Both approaches have their advocates and critics. This is not the place to debate their relative merits (see Cline and Williamson 2008, and Frankel 2008 for an excellent exchange). What can be safely said is: (1) that the two approaches are complementary, deploying different time perspectives for analyzing currency misalignment; and (2) that the more they provide estimates that are correlated, the greater the degree of confidence that one can have in either.

There is, however, one aspect of the PPP-based approach that is inadequately appreciated. Like the IMF’s Consultative Group on Exchange Rate Issues (CGER) model described in Lee et al. (2008) and unlike the approach in Cline and Williamson (2008), PPP-based approaches have the virtue of being general equilibrium in nature in the sense that all countries’ equilibrium exchange rates are determined simultaneously, ensuring some degree of consistency across estimates for countries (for example, not all countries can simultaneously have undervalued or overvalued exchange rates).<sup>3</sup>

1. John Williamson (1983) propounded the notion of a fundamental equilibrium exchange rate (FEER), which is the basis for more recent estimates by Cline and Williamson (2008). These estimates are done country by country. In contrast, the IMF has a multicountry general equilibrium model that relies on an expanded set of macroeconomic variables (including, for example, demographic variables) and ensures consistency in the estimates across countries (see Lee et al. 2008).

2. Rogoff (1996) was an early example of using the Penn World Tables to measure currency misalignment.

3. The simultaneous determination of equilibrium exchange rates across

Thus, the BS relationship is captured in the following equation:

$$\ln P_i = \alpha + \beta \ln Y_i \quad (1)$$

where  $P_i$  is the price level of GDP (ratio of the PPP to market exchange rates) for country  $i$ ,  $Y_i$  is its GDP per capita in PPP terms, and  $\beta$  measures the equilibrium impact of economic growth on the real exchange rate.

After estimating equation 1, the predicted value of the real exchange rate for each country  $P_i^*$  can be obtained. The difference between the actual real exchange rate and the predicted one is then a measure of currency misalignment on the PPP approach:

$$\text{Thus } UVAL_i = \ln P_i^* - \ln P_i \quad (2)$$

where  $UVAL_i$  is the measure of undervaluation of country  $i$ 's currency (i.e., a positive value of  $UVAL_i$  when a country's actual price level of GDP is lower than what is predicted by the BS relationship implies that its real exchange rate is undervalued).

## ESTIMATES FOR CHINA

The analysis in JLPS (2009) suggests that BS relationship in equation 1 is best estimated: (1) for the benchmark year for which the most recent disaggregated price data are collected; and (2) that the estimation is also best restricted to the sample of countries (benchmark countries) for which disaggregated price data exist.<sup>4</sup> Now, the most recent disaggregated price data were collected for the year 2005 and have been incorporated in the World Bank's World Development Indicators' (WDI) estimates for  $Y$  and  $P$  in equation 1 above.

Estimation of equation 1 using these data for benchmark countries yields a figure of 15 percent for China's undervaluation for 2005. The estimated equation with relevant statistical descriptors is reproduced in column 1 of table 1.

At first blush, this is very close to Reisen's estimate of 12 percent reported in the *New York Times*. The problem with this estimate is that it is based on data for China (and India) that have been seriously questioned. Deaton and Heston (2009), perhaps amongst the most thoughtful and careful analysts of

these new data, have suggested that the price level of GDP for China has been overestimated by about 20 percent and its per capita PPP GDP underestimated by about that amount.

Their critique is twofold. First, they point to the fact that the disaggregated prices collected for China as part of the 2005 ICP project were predominantly for urban areas, which imparted a serious upward bias to Chinese prices.<sup>5</sup> Second, they argue (and here they echo the point also made by Bhalla 2008), based on the work of Pritchett (1997), that the new per capita GDP estimates for 2005 combined with the growth rate (of 5.5 percent) of the Chinese economy for the period 1952–2004 would yield a per capita GDP estimate for 1952 that would be well below the minimum level of per capita GDP that history suggests is required to sustain a population, or that has ever been observed for more than a short period. The only way historical growth rates can be reconciled with above-subsistence levels of income in 1952 would be to raise the GDP estimate for 2005 by about 20 percent. This, in turn, would require the price level or the real exchange rate also to be raised by about 20 percent.

If this critique by Deaton and Heston (2009) is accepted, and equation 1 is reestimated adjusting  $P$  and  $Y$  for China by, say, 10 and 20 percent (to cover the range of possible bias identified by Deaton and Heston 2009), respectively, the new estimates for Chinese undervaluation change significantly.<sup>6</sup> In column 2 of table 1, estimates are reported when a 10 percent adjustment is made and in column 3 when a 20 percent adjustment is made. With these corrections, Chinese undervaluation rises to 26 percent and 37 percent, respectively (figure 1 plots the relationship corresponding to the 20 percent adjustment).

One way of checking which of these estimates of undervaluation is plausible is in fact to estimate equation 1 based on the most recent version of the PWT, namely version 6.3, which was released in August 2009. The disadvantage of using these data is that they are prone to the problems described in JLPS (2009). The advantage of using these is that they are perhaps less prone to the bias in estimating price level and GDP associated with the estimates in the WDI that afflict, in particular, countries such as China. These caveats need to be borne in mind when evaluating estimates from this source.

When equation 1 is reestimated using PWT 6.3 data, the undervaluation estimate for China is 47 percent as reported in column 4 of table 1.

countries arises from the way disaggregated price data from different countries are aggregated to yield the international prices for all goods across countries (see JLPS 2009, appendix 1 for a description and Deaton and Heston 2009 for some of the problems and complexities in such an aggregation).

4. Technically speaking, JLPS (2009) implies that estimating equation 1 would be problematic because of errors in measuring both the left-hand and right-hand variables. These errors are not random but in fact systematic across time and across countries, leading to biased and inconsistent estimates of the parameters in equation 1.

5. Ravallion (2010) suggests that China's price level was overstated in the 2005 ICP by about a third because of the urban bias of data collection.

6. In principle, changing individual Chinese prices would affect all the international prices and the PPPs for all countries, but as an approximation, and given China's relatively small size in world consumption, these consequential changes can be ignored.

**Table 1 PPP-based estimates of renminbi undervaluation**

	World Development Indicators (WDI)	WDI with China data corrected à la Deaton and Heston (2009) <sup>1</sup>	WDI with China data corrected à la Deaton and Heston (2009) <sup>2</sup>	Penn World Tables (version 6.3)
	(1)	(2)	(3)	(4)
<b>Data set</b>	<b>Dependent variable is log of the price level of GDP in 2005</b>			
Coefficient on constant term	1.94	1.94	1.94	0.7
<i>t</i> -statistic	11.36	11.33	11.31	2.17
Coefficient on log of per capita GDP (PPP)	0.234	0.234	0.234	0.351
<i>t</i> -statistic	11.84	11.82	11.81	10.02
R-square	0.55	0.55	0.55	0.46
Number of observations	141	141	141	144
Magnitude of of undervaluation (percent)	14.50	26.20	36.90	47.40
Average magnitude of undervaluation (percent)	31.30			

1. China's price level is decreased by 10 percent and GDP per capita increased by 10 percent.

2. China's price level is decreased by 20 percent and GDP per capita increased by 20 percent.

Source: Authors' calculations.

All these estimates are for 2005. But they can be updated for the most recent period (say end-March 2010) by using the estimated  $\beta$  to project how the real exchange rate should have evolved between end-2005 and today. This can then be compared with how much the renminbi actually evolved, obtain the difference between the two, and adjust the 2005 estimate accordingly.

Between 2005 and end-March 2010, China's per capita GDP grew about 45 percent; applying the average of the four  $\beta$  estimates suggests that the real exchange rate should have appreciated by a further 12 percent. The actual real appreciation of the renminbi was about the same measured both against the dollar and against a basket of goods (based on the real exchange rate indices produced by JPMorgan, Citi, and the Bank for International Settlements [BIS]), suggesting that the estimate for 2005 from the equation is broadly also the undervaluation estimate for today.

Since each of the four estimates suffers from limitations, a reasonable approach would be to average all four. This yields an undervaluation estimate for China of about 31 percent against the US dollar, which is my preferred PPP-based estimate.<sup>7</sup>

## WAY FORWARD

If this estimate (which is quantitatively similar to the estimates of other methods) is right, the policy question of how

to address renminbi undervaluation remains alive and urgent. Many analysts argue that renminbi appreciation would be desirable because that would be in China's own interests. There is no doubt that China's currency policy threatens to create a number of distortions for China, including an over-reliance on foreign as opposed to domestic demand, a reserve buildup with large potential valuation losses in the future, and the continuation of financial repression that current currency policy requires and sustains.

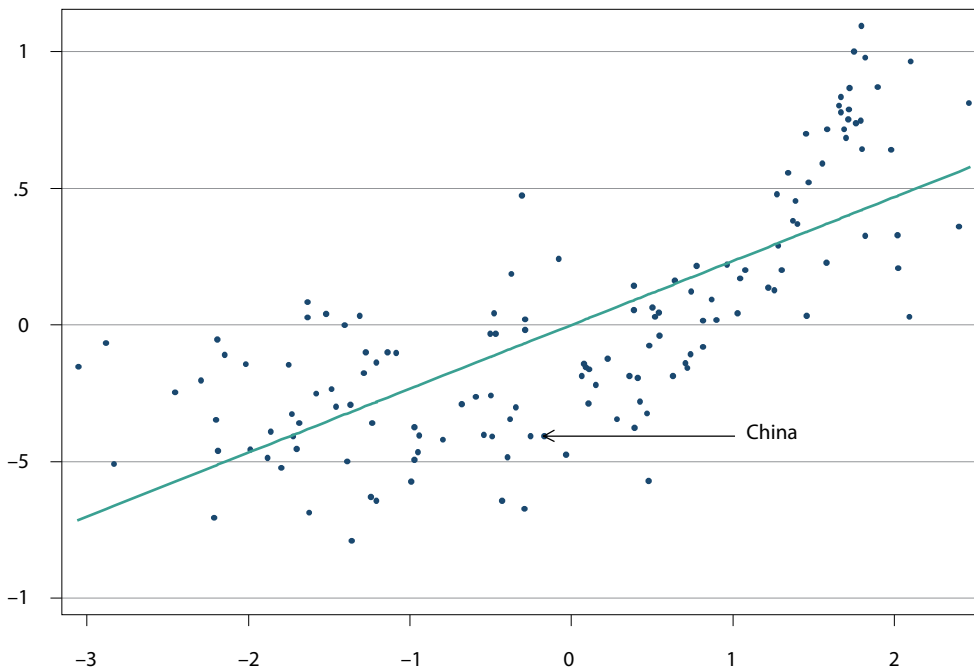
It is one thing for outsiders to warn of these potential dangers. But it is something else to confidently assert that changing the current policy would be better for China. It is not just that the call to change policies ignores the wrenching social and political change that governments have to deal with and that governments around the world naturally shy away from. Humility is in order when telling a country that has posted the most spectacular rates of economic growth for the longest periods of time in the history of humanity that other policies would have worked better. It must be pointed out that the most spectacular rates of economic growth have also been accompanied by the most spectacular rates of growth of consumption per capita. So, while it is possible (but by no means certain) that the Chinese government might be sacrificing consumption for extra growth in counterfactual time; it is certainly delivering rapid growth rates of consumption in real time.

So, the more justified case for a change in China's currency policy is the impact not on China itself but on the rest of the world. Two aspects of this impact are worth emphasizing. First, in a cyclical sense, China's current account surplus (reflecting its currency undervaluation) creates a demand problem.

7. The magnitude of undervaluation is also statistically significant: when a China dummy is introduced in the regression in equation 1, its coefficient is tightly estimated and significant at the 1 percent confidence level.

**Figure 1 The Balassa-Samuelson relationship, 2005**

Log of PPP-adjusted per capita GDP (residuals)



coef = .23363622, (robust) se = .01978862, t = 11.81

Note: This figure is the pictorial counterpart of the regression presented in column 3 of table 1 above.

Source: Authors' calculations.

Paul Krugman has estimated that this demand-contracting impact of China's policies implies higher unemployment in the United States of about 1.7 million. Bergsten (2010) estimates this impact as closer to 600,000.

Second, as argued in Subramanian (2010), an undervalued exchange rate is above all a protectionist trade policy because it is the combination of an import tariff and an export subsidy. It follows therefore that the real victims of this policy are other emerging-market and developing countries—because they compete more closely with China than the United States and Europe, whose source of comparative advantage is very different from China's. In fact, developing countries face two distinct costs from China's exchange rate policy.

In the short run, with capital pouring into emerging-market countries, their ability to respond to the threat of asset bubbles and overheating is undermined. Emerging-market countries such as Brazil, India, and South Korea are loath to allow their currencies to appreciate—to dampen overheating—when that of a major trade rival is pegged to the dollar.

But the more serious and long-term cost is the loss in trade and growth in poorer parts of the world. Dani Rodrik (2010)

estimates that China's undervaluation has boosted its long-run growth rate by more than 2 percent by allowing greater output of tradable goods, a sector that was the engine of growth and an escape route from underdevelopment for postwar successes such as Japan, South Korea, and Taiwan.

Higher tradable goods production in China results in lower traded goods production elsewhere in the developing world, entailing a growth cost for these countries. Of course, some of these costs may have been alleviated by China's rapid growth and the attendant demand for other countries' goods. But China's large current account surpluses suggest that the alleviation is only partial.

The key therefore is to recognize that the renminbi is a problem not just for the United States but the world and, as such, requires a multilateral rules-based solution rather than a bilateral confrontation between Washington and Beijing. The US Treasury secretary's recent decision to defer pronouncing on China's exchange rate as well as the manner in which this delay was presented are clearly aimed at multilateralizing the China currency issue. This is a very desirable step forward. The question is: What form should this multilateralization take?



The International Monetary Fund (IMF) is, of course, the natural multilateral forum for addressing exchange rate issues. But the IMF suffers from problems of eroding legitimacy and inadequate leverage. Emerging market countries still complain that its antiquated governance structure does not reflect economic realities.

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Moreover, the IMF has rarely, if ever, effectively influenced the policies of large creditor countries even where such policies have had significant negative effects on others. The IMF and its managing director have become more vocal in characterizing the renminbi as “substantially undervalued,” but this has been water off the Beijing duck’s back. The IMF is, sad to say, toothless.

The World Trade Organization (WTO) is a natural forum for developing new multilateral rules. First, undervalued exchange rates are de facto protectionist trade policies because they are a combination of export subsidies and import tariffs. Second, the WTO has a better record on enforcement of rules. Its dispute settlement system, although not perfect, has been reasonably effective in allowing members to initiate and settle disputes. The WTO has greater legitimacy than the IMF—developing countries, even smaller ones, have been active in bringing disputes to the WTO. Tiny Antigua (population: 69,000) managed to successfully challenge US gambling laws through the WTO.

Although the WTO has some rules on exchange rate–related action, they are too vague to provide a basis for effective enforcement. What is needed is a new rule in the WTO proscribing undervalued exchange rates.<sup>8</sup> The irony is that export subsidies and import tariffs are individually disciplined in the WTO, but their lethal combination, “an undervalued exchange rate,” is not. But the rules would have to be carefully designed because a competitive exchange rate can be a legitimate policy tool for development. The rules should aim to address those situations where the adverse costs imposed on partner countries from an undervalued exchange rate start to become large relative to the benefits to the country (Mattoo and Subramanian 2009 elaborate on the content and implementation of possible new rules).

The IMF would continue to be the sole forum for broad

exchange rate surveillance. But in those rare instances of substantial and persistent undervaluation, we envisage a more effective delineation of responsibility, with the IMF continuing to play a technical role in assessing when a country’s exchange rate was undervalued, and the WTO assuming the enforcement role.

How would this new rule be incorporated in the WTO? Essentially through negotiation. For example, the G-20 over the next few months could examine the Chinese issue and call upon countries to indeed negotiate such new rules in the WTO. China would have to agree with its other trading partners in the WTO to negotiate new rules aimed at disciplining undervalued exchange rates.

Such an approach has several advantages. China would not be seen as a victim of bilateral targeting, but part of a cooperative approach to settle an issue that could well go beyond its currency. The remedy would be new broad-based rules rather than just renminbi revaluation. There would be a large collateral benefit too. Negotiating new and important rules would help revitalize the WTO, which has languished because of the unfinished Doha Round of trade talks.

## CONCLUSION

New estimates for the undervaluation of the Chinese currency based on the purchasing power parity approach yield a figure that is closer to 30 percent rather than the 12 percent reported recently in Reisen (2009) and in the *New York Times*. These estimates—all of which come with qualifications and caveats—are based on applying new insights about the way in which the PPP data are compiled; on using new data that have become recently available; and on correcting existing estimates for the biases in the data used for China in particular.

The best PPP-based estimate for renminbi undervaluation is one that can combine the methodology suggested by JLPS (2009) with data that corrects for the biases in the 2005 ICP project. It will be possible to undertake such an estimate when version 7 of the Penn World Tables—which will correct for some of the biases in the 2005 ICP data and hence in the World Bank’s WDI PPP estimates—is released later this year. But for now, the best (or at least the least problematic) PPP-based estimate for renminbi undervaluation remains about 30 percent.

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