Estimates of the Equilibrium Exchange Rate of the Renminbi: Is There a Consensus and, If Not, Why Not?

WILLIAM R. CLINE and JOHN WILLIAMSON

Is there a consensus on what the equilibrium exchange rate of the renminbi is? If not, why not? The answer to the first of the two questions is clearly no. The 18 studies summarized in table 4.1 reveal that the literature offers widely differing answers, even sticking to post-2000 estimates and even when one recognizes—as not everyone has done—that an effective exchange rate is a totally different creature from a bilateral dollar exchange rate and that one should expect estimates of undervaluation on each concept to be quite different.[1]

However, of all 18 studies, only one (Wang 2004) tries to argue that the renminbi might be overvalued. Moreover, the average estimates indicate substantial undervaluation. The simple average of the 14 estimates of the correction needed in the real effective exchange rate (REER) is a 19 percent appreciation; the corresponding simple average of the 16 estimates

William R. Cline is a senior fellow jointly at the Center for Global Development and the Peterson Institute for International Economics. John Williamson, senior fellow at the Peterson Institute, has been associated with the Institute since 1981.

1. Moreover, several leading economists wish (or wished before July 21, 2005) to maintain an unchanged bilateral dollar exchange rate and therefore presumably do not regard it as meaningful to speak of misalignments, including Robert Mundell (2004); Ronald I. McKinnon (2007); and Michael Dooley, David Folkerts-Landau, and Peter Garber (2003).

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for the bilateral rate against the dollar is an appreciation of 40 percent.[2] The undervaluation shows signs of growing worse over time, as the average real effective appreciation needed rises from 17 percent in studies using data from the period 2000–2004 to 26 percent in those using data from 2005–07 (table 4.1).[3] Thus, although most of this paper concerns the answer to the second question, the source of differences among the estimates, dispersion of the individual results should not divert policy attention away from the forest to the trees.[4]

We first review the methodological issues associated with the three main measurement approaches: purchasing power parity (PPP), behavioral equilibrium exchange rate (BEER), and fundamental equilibrium exchange rate (FEER)—as well as the concepts of multilateral (real effective) and bilateral misalignment.[5] We then examine the results of each of the studies considered, grouped by each of the three approaches. We conclude with an overview of the estimates and the reasons for the differences among them.

Approaches and Methodological Issues

Purchasing Power Parity

One ancient if not very well-respected approach to identifying equilibrium exchange rates is to find the exchange rate that would lead to PPP. The *Economist*'s Big Mac Index falls squarely into this category, even though the price index used to establish PPP contains only one good. Much more meaningful are the several estimates based on a so-called enhanced-PPP approach, which starts from the strong empirical regularity linking per capita income with the REER. It has been rationalized by Bela Balassa (1964) and Paul Samuelson (1964), who suggest that the productivity rise

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2. The extreme Big Mac estimate of a needed appreciation of 138 percent is omitted from this average because a simple PPP approach is widely regarded as inappropriate.

3. The corresponding drop in the bilateral correction from 42 to 38 percent is misleading because none of the enhanced-PPP studies is for the latter period, and it is this approach that systematically produces the highest estimates of undervaluation.

4. Thus, we fundamentally disagree with Dunaway, Leigh, and Li (2006) and Cheung, Chinn, and Fujii (2007) that the variations are so wide as to preclude drawing policy implications.

5. Throughout this paper we measure REER in the normal way, as the price of a nation's output relative to the trade-weighted price of other nations' outputs, typically deflated over time by consumer price indices. The Salter-Swan-Scandinavian-Chicago-Latin American alternative definition, as the ratio of the domestic price of tradables to the domestic price of nontradables, corresponds to this measure so long as the price of tradables moves 1:1 with the exchange rate and the price of nontradables is unaffected by the exchange rate.

**Table 4.1 Estimates of renminbi appreciation needed to eliminate
undervaluation** (percent)

Study	Year	REER range	Bilateral dollar rate range	Approach
Anderson (2006)	2006	—	18 to 25	FEER
Bénassy-Quéré et al. (2004)	2001	16	41 to 44	BEER
Bénassy-Quéré et al. (2006)	2004	31 to 45	30 to 59	BEER
Big Mac	2007	—	138	PPP-S
Bosworth (2004)	2004	—	67	PPP-E
Cheung, Chinn, and Fujii (2007)	2007	—	≈100	PPP-E
Cline (2005)	2005	21	45	FEER
Cline (2007)	2007	11 to 18	34 to 39	FEER
Coudert and Couharde (2005)	2003		41 to 50	PPP-E
	2002		18	BEER
	2002–03	23 to 30	44 to 54	FEER
Frankel (2006)	2000		56	PPP-E
Funke and Rahn (2005)	2002	3 to 6	12 to 14	BEER
Goldstein (2004)	2004	15 to 30	—	FEER
Goldstein and Lardy (2006)	2004	20 to 35	—	FEER
Goldstein and Lardy (chapter 1)	2007	30 to 55	—	FEER
Jeong and Mazier (2003)	2000	29	67	FEER
MacDonald and Dias (2007)	2007	8 to 42	—	BEER
Stolper and Fuentes (2007)	2007[a]	—	7	BEER
	2007[b]		15	FEER
Wang (2004)	2003	5	—	BEER
		0 to 5		FEER
		0 to –5		FEER
Wren-Lewis (2004)	2003	—	19 to 22	FEER
Average	All	19	40[c]	
Average A	2000–2004	17	42[c]	
Average B	2005–07	26	38[c]	

BEER = behavioral equilibrium exchange rate
FEER = fundamental equilibrium exchange rate
PPP = purchasing power parity
REER = real equilibrium exchange rate
-S = simple
-E = enhanced

a. Goldman Sachs dynamic equilibrium exchange rate (GSDEER) model.
b. Elasticities model.
c. Excluding Big Mac.

associated with development is concentrated primarily in tradables. The
consequence is that the ratio of the market exchange rate to the PPP ex-
change rate is well below unity for low-income countries and eventually
rises to approximately unity at the per capita income levels of rich coun-

**Figure 4.1   Ratio of market exchange rate to PPP exchange rate
and real per capita income**

market exchange rate/PPP exchange rate
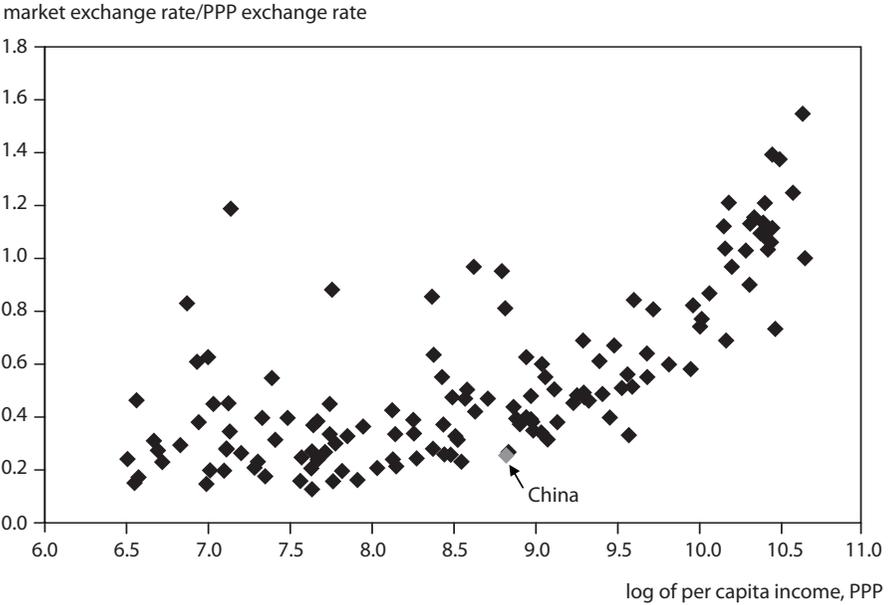
PPP = purchasing power parity

Source: World Bank (2007b).

tries, as figure 4.1 illustrates.[6] Undervaluation or overvaluation is defined
as the percentage by which a country's exchange rate diverges from the re-
gression line linking per capita income and the real exchange rate (RER).[7]
It is possible for the regression line to take account of other variables be-
yond real per capita income that may systematically influence RERs, such
as net foreign assets or the terms of trade. In this case, enhancement of the
PPP approach goes well beyond including a Balassa-Samuelson effect and
incorporates variables that often feature in the BEER approach, such as
productivity growth and net foreign assets.

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6. Data are for 2005 for 138 countries with population exceeding 1 million (World Bank
2007b).

7. Note that this relationship is also used by Rodrik (2007) and Bhalla (2007) to identify un-
dervaluation. Both authors argue that undervaluation can contribute to growth, Rodrik be-
cause of the need to offset purported greater contracting difficulties in the tradable sector
and Bhalla more simply in a neomercantilist sense that does not take account of pressures
on inflation that would result from chronic current account surpluses (Meade's "internal im-
balance").

We are skeptical of the enhanced-PPP approach in general and its application to China in particular. One major limitation is that, by definition, the US dollar can never be overvalued or undervalued: It is the numeraire for PPP exchange rate equal to market rate. This is a gaping hole for an analytical approach considering that the US current account deficit currently absorbs the vast bulk of the combined surpluses of the rest of the world. More generally, ample historical experience—including that of China today—shows that the deviation of the PPP/market exchange rate ratio (PPP/er) from the international norm can be a wholly misleading guide as to whether a country has a current account surplus or deficit, let alone whether the balance is a meaningfully sustainable equilibrium.

For China, it is well known that until recently, the available price surveys were much less reliable than those for most countries (Cooper 2005, Heston 2001, Lardy 1994). It is also well known that China was an extreme outlier, with low domestic prices. The presumption was thus that China's prices were measured unreliably, at below actual levels. If so, then the percentage shortfall of x from the actual level would not only impute an undervaluation of x percent, but also overstate the real per capita income on the horizontal axis, thereby making the seeming shortfall from the international line even greater and registering an undervaluation greater than x percent. Indeed, after the conference that led to this volume, the World Bank released its 2007 PPP estimates in its International Comparison Program. China participated in the survey for the first time ever and India for the first time since 1985. The new estimates sharply reduced the ratio of the PPP exchange rate to the market rate for both countries. For China, the ratio fell from 3.3 to 2.4; for India, it fell from 5 to 3 (World Bank 2007a, 2007b).
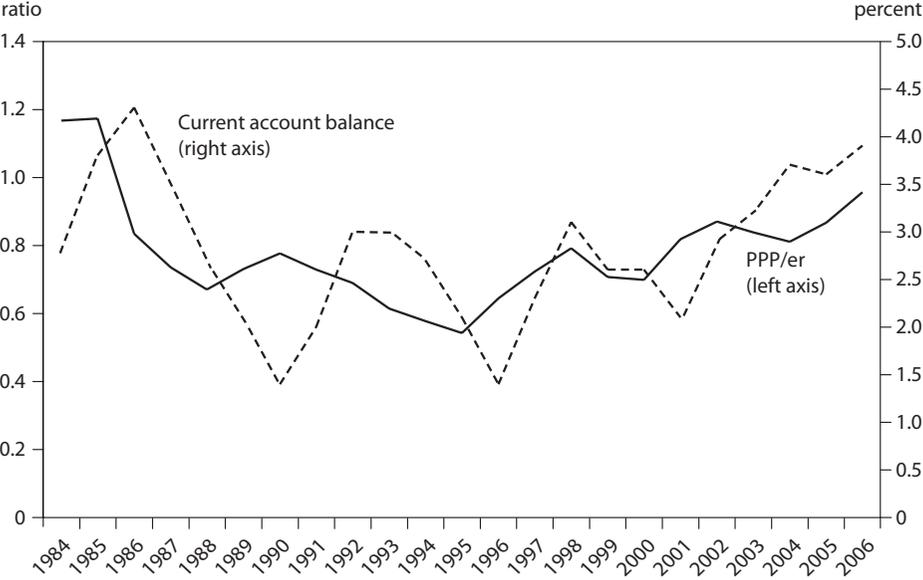
Figure 4.2 illustrates the problems with interpreting divergence from adjusted PPP as a guide to exchange rate policy. The figure shows the PPP/er on the left vertical axis and the current account surplus as a percent of GDP on the right vertical axis.[8] When the PPP/er measure is higher, the currency is asserted to be more undervalued. The first panel, for Japan, shows a reasonably clear correlation between this measure of the degree of exchange rate undervaluation and the current account. Such direct comparisons can be made for Japan because it is now at about the same per capita income as the United States and so does not require Balassa-Samuelson adjustment. Thus, from 1995 to 2006 the PPP/er ratio has risen from 0.54 to 0.95; over the same period the current account surplus has risen from 2.1 to 3.9 percent of GDP.

However, the PPP metric seriously misjudges even Japan's misalignment because the level for the entire period suggests that the yen was con-
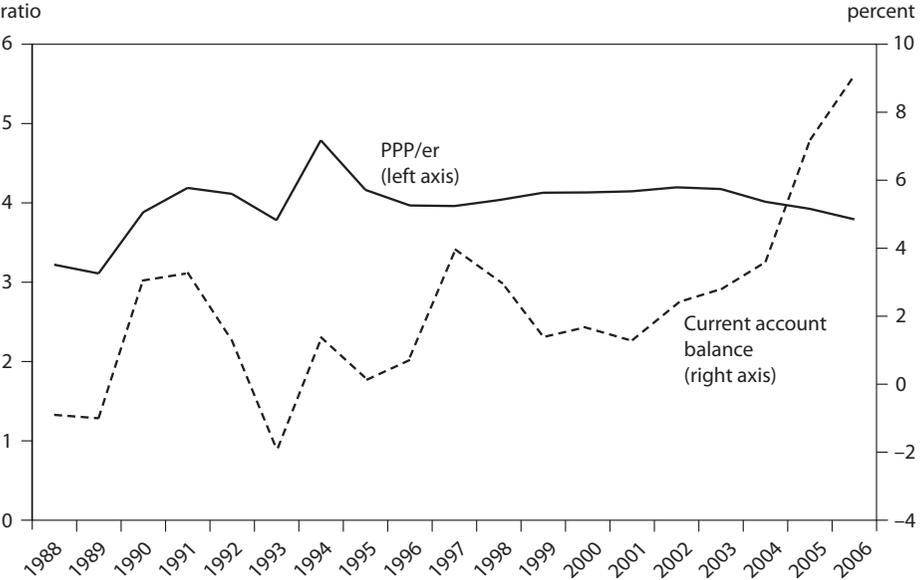
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8. Data are from the IMF *World Economic Outlook* database. The PPP/er ratio is the ratio of GDP in dollars at PPP to nominal dollar GDP at the current exchange rate.

Figure 4.2   Ratio of PPP exchange rate to market exchange rate (PPP/er) and current account balance

a. Japan, 1984–2006

ratio | percent

Current account balance (right axis)

PPP/er (left axis)

(x-axis years: 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006)

b. China, 1988–2006

ratio | percent

PPP/er (left axis)

Current account balance (right axis)

(x-axis years: 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006)

Source: IMF (2007).

tinuously overvalued rather than undervalued: For 1986 and all years thereafter, the ratio of the PPP exchange rate to the actual exchange rate is below unity. If we take 2 percent of GDP as a more appropriate current account equilibrium range for Japan than 4 percent, then the equilibrium PPP rate for Japan implied by the figure is only about 0.6. That is, the international basket of goods and services can cost about 50 percent more in Japan than in the United States with external equilibrium still being maintained. Thus the Japan example suggests that the PPP approach may be useful to examine trends but not to identify over- or undervaluation at a point in time.

The PPP approach is even less consistent with the current account outcome for China. The current account surplus soared from 1 percent of GDP in 1994–96 to 9 percent in 2006, when the PPP-gauged undervaluation registered a small reduction. This rough comparison does not incorporate a Balassa-Samuelson adjustment, but such an adjustment would merely accentuate the conclusion.

Behavioral Equilibrium Exchange Rate

A BEER aims to estimate the index level to which the market exchange rate might be expected to revert in the medium or long run, given an absence of shocks.[9] Unlike the enhanced-PPP approach, which deals in direct price comparisons for internationally comparable baskets of goods, the BEER deals with indexes over time of domestic versus international prices and exchange rates. It implicitly assumes that the currency was, on average, in equilibrium over the period for which the estimation was made, which means that it is only possible to use the BEER to determine whether a currency is under- or overvalued compared with its own past averages, not on an absolute basis.

To determine whether a currency is under- or overvalued, the analysis typically examines the departure of the country's observed REER at the latest date available from the equation-predicted BEER, but this method is only as good as the assumption of an equilibrium average real exchange rate over the sample period. The BEER is typically specified as a function of productivity (or, what amounts to the same thing, of relative productivity in the tradable and nontradable goods sectors); net foreign assets (NFA); openness (high protection implies a limited need for exports to balance the current account and therefore allows an uncompetitive currency); and sometimes the level and/or composition of government expenditure. It may also be specified as a function of the average current account balance, or of variables (e.g., demographic) that are thought to influence the average current account balance. Other variables are occasionally added.

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9. The BEER approach was introduced by Clark and MacDonald (1998).

BEERs are the basis on which estimates of equilibrium real exchange rates (ERERs) are usually calculated.[10]

A problem with some BEER estimates is that they are calculated from a regression for a single country rather than from cross-country experience. Such studies are surely incapable of examining whether a country's policy intervention is or is not making the country's currency over- or undervalued. Suppose a country persistently intervenes to keep its currency from appreciating while accumulating ever-rising reserves. By most definitions, the country's currency will be increasingly undervalued. But if a regression is run for this country alone, comparing today's exchange rate against an earlier exchange rate using such variables as NFA, the premise that the country must have been in equilibrium for the full period, on average, will force a negligible coefficient on NFA. Meanwhile, a larger coefficient estimated from cross-country data would diagnose increasing undervaluation.

Fundamental Equilibrium Exchange Rate

The third approach is the FEER, or macroeconomic balance, concept of equilibrium. One of the present authors (Williamson 1983) introduced this concept into academic analysis. The International Monetary Fund (IMF) has widely employed it, including as the basis for the first and third approaches to estimating equilibrium exchange rates described in IMF (2006). The basic idea is to search for a set of exchange rates that will simultaneously achieve internal and external balance in every country (Meade 1951). Internal balance is defined as noninflationary full employment or whatever is judged to be the optimal pressure of demand. In an era when long-run Phillips curves are widely believed to be vertical—except, perhaps, at minimal inflation rates—there is not much room for arguing about levels of internal balance. External balance is far more controversial. Everyone agrees that a current account balance has to be sustainable to be called external balance, but it is easy to argue that this criterion does not pin down values uniquely. Many authors have argued that it has to be a normative concept, and that is certainly one interpretation.[11]

Traditionally, the assumption has been that the current account target should be either a moderate deficit—1 to 3 percent of GDP—or at most a

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10. They also provide the basis for the second of the IMF calculations of exchange rate equilibria (IMF 2006).

11. It was presumably an attempt to escape from a normative definition of external balance that led the IMF to introduce its third concept of equilibrium exchange rates, which defines these as the set that would achieve current account outcomes that would keep ratios of NFA to GDP unchanged.

modest surplus for most developing countries and a surplus for rich countries, on the grounds that capital should be expected to flow from the latter to the former. Beyond identifying the target current account, two additional elements are key to estimating under- or overvaluation. First, it is necessary to determine how much of the present current account divergence from the target is strictly cyclical and transitory, a step that turns out to be critical for China.

Second, it is necessary to know the appropriate price elasticities and pass-through ratios for exports and imports to calculate how much the exchange rate would need to move to close the gap between the cyclically adjusted actual and target current account balances. For China, an important consideration in judging trade elasticities is the relatively large share of imported intermediates used to produce exports. Even after accounting for this influence, China's current account should be expected to show relatively high response to the real exchange rate in light of its large share of trade in GDP.[12]

Bilateral Versus Multilateral Misalignment

Whichever of the three approaches is used, it is important to recognize the difference between estimates of bilateral undervaluation against the US dollar and multilateral undervaluation of the currency on a trade-weighted real effective basis. The central point in this regard is that the relationship between them is contingent: The degree of difference will depend on whether there is a generalized realignment of other currencies against the dollar or instead a correction by China alone. In the extreme case of revaluation solely by China, the two measures are identical. In the more policy-relevant context, in which much of Asia—including Japan, Malaysia, Singapore, Taiwan, and arguably Philippines, India, and Thailand—probably would also tend to revalue if China were to do so, the bilateral appreciation against the dollar will be considerably larger than the real effective appreciation.

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12. Without special treatment for component imports used in exports, Cline (2005) estimates that a 1 percent rise in the real exchange rate should be expected to reduce China's current account balance by 0.3 percent of GDP. Exports of goods and services were 40 percent of GDP and imports 32 percent in 2006. Perhaps 40 percent of imports are for intermediates used in exports, so half of imports are reexportable components and half are final goods. Suppose the price elasticity is unity for exports and for final-good imports. With unitary elasticity, appreciation will leave the renminbi value of final-good imports unchanged. The other half of imports will decline linearly with exports. So a 1 percent real appreciation will reduce exports by 1 percent or 0.4 percent of GDP, while reducing component imports by 1 percent or 0.16 percent of GDP, placing the overall result at 0.24 percent of GDP reduction in the current account.

Review of Estimates

PPP-Based Studies

The only simple direct PPP comparison is the *Economist's* Big Mac Index.[13] Specifically, we have included the latest calculation found on the internet at the time of writing, which suggested an undervaluation of 58 percent in mid-2007.[14] Correspondingly, it would require a rise of 138 percent in the renminbi against the US dollar to place the cost of a Big Mac at the same price in dollars in the two countries.[15]

The first enhanced-PPP study in table 4.1 is Bosworth (2004), prepared for the Tokyo Club. Most of it is devoted to expounding the principles involved in calculating misalignments, but when the author mentions figures, he points out that, while a simple PPP comparison would suggest that the renminbi's value would need to quadruple, the standard Balassa-Samuelson analysis implies that this would be excessive. Accounting for per capita income, the renminbi is still undervalued, but only by an estimated 40 percent, indicating that a revaluation of 67 percent would be needed to eliminate undervaluation. However, Bosworth (2004) notes the fragility of this approach and points out that the departure from the PPP line is "even larger for India, a country whose exchange rate has attracted little claim of being undervalued" (p. 11).

Coudert and Couharde (2005) have entries in all three approaches. Their enhanced-PPP estimate places Chinese undervaluation between 41 percent and just over 50 percent, depending on whether they omit certain countries from the regression.

Frankel (2006) primarily discusses the merits of various exchange rate regimes for China but also utilizes the enhanced-PPP approach; on that basis, Frankel estimates that the renminbi was about 36 percent undervalued relative to the dollar in 2000 (i.e., a revaluation of 56 percent would be required to eliminate undervaluation). Frankel also finds, however, that the undervaluation was almost identical to this amount in 1990 (at 34 percent). The unchanged degree of undervaluation in the face of far higher current account surpluses in recent years raises further doubts about the reliability of the enhanced-PPP approach in general.

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13. This section should be read in light of the sharp downward revision of China's ratio of PPP to market exchange rate in the 2007 World Bank International Comparison Program results released after the conference at which this paper was presented. That ratio was only 2.4 to 1, about half the ratio in the Cheung et al. (2007) study considered below. Broadly, the implied errors in measurement in past studies suggest that the entire set of enhanced-PPP studies for China is unreliable and that these studies should be reestimated using the new survey results.

14. *Economist*, July 5, 2007.

15. For an undervaluation of x percent, the appreciation needed for correction is 100 ([1/(1 − .01x] −1).

The most recent enhanced-PPP study for China is that of Cheung, Chinn, and Fujii (2007). They estimate their model using annual data over 1975–2004 and have by far the largest country sample (132 countries). The equation for price level relative to US price level is estimated on a joint time series/cross-section basis, and a correction for serial correlation is introduced. The renminbi is estimated to be undervalued by about 50 percent in various alternative specifications, implying a needed revaluation of about 100 percent. However, the authors then argue that there is no evidence of undervaluation because the results lie within two standard errors of zero.

We suspect that the authors have conducted the wrong test. The relevant standard deviation is not that for the observations (i.e., the square root of the sum of squared residuals—but instead the standard deviation of the regression line itself, based on the standard errors of the parameter estimates. These are actually estimated quite tightly: The standard error is only 8 percent of the constant coefficient and 2 percent of the coefficient on the log of relative income. The central regression line states that China's ratio of actual to PPP exchange rate should be 0.481, at China's relative PPP per capita income. Dropping the line by two standard deviations of the regression estimates places the lower corridor at 0.449 at the same relative income. In contrast, China's actual PPP/er ratio is only 0.21, far below two standard deviations of the regression estimate.[16] So although we consider the enhanced-PPP approach to be fragile and less reliable than the BEER and FEER alternatives, we do not consider the statistical inference by Cheung, Chinn, and Fujii to provide a sound basis for rejecting the approach.

The simple average for the needed real appreciation bilaterally against the dollar in the four enhanced-PPP approaches in table 4.1 is 67 percent, considerably above the average of the other approaches. Even after enhancement for the Balassa-Samuelson effect, then, the PPP approach appears to give high estimates for the amount of correction needed. This may reflect a bias introduced by an understatement of the price of an internationally comparable basket of goods in China, as suggested above.

BEER Estimates

BEER estimates can differ because of differences in independent variables, estimation periods, country samples, and estimating techniques. All of the BEER studies include the productivity variable, and all except

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16. The regression estimate is $z = -.134 \ (.011) + 0.299 \ (.006) \ \ln(y^*/y^*_u)$, where z is the logarithm of the ratio of the market to the PPP exchange rate, standard errors are in parentheses, and the final term is the logarithm of China's PPP per capita income relative to that of the United States (which turns out to be –2). The lower corridor for two standard deviations of the regression coefficients would turn this equation into $z = -.156 + 0.311 \ \ln(y^*/y^*_u)$. Taking the corresponding exponents yields the text estimates.

one (MacDonald and Dias 2007) include net foreign assets. It turns out, however, that the crucial distinction in this set of studies is whether the model is estimated using an international panel approach or instead uses data solely for China.

The two BEER studies in table 4.1 by Agnes Bénassy-Quéré and her coauthors (Bénassy-Quéré et al. 2004; Bénassy-Quéré, Lahrèche-Révil, and Mignon 2006) aimed to estimate the equilibrium exchange rate of the renminbi in the context of simultaneously estimating the equilibrium exchange rates of all the currencies of Group of 20 countries. Bénassy-Quéré et al. (2004) estimate the real effective appreciation needed to eliminate undervaluation at 16 percent and the corresponding bilateral rise of the renminbi against the dollar at about 40 percent.

The second study, Bénassy-Quéré et al. (2006), estimated using quarterly data from 1980 to 2004 for 15 countries, pays special attention to how much impact the treatment of the residual countries has on the estimate of misalignment. Unfortunately, this impact seems to be considerable. In one treatment, they consider the 15 major currencies as though they were the whole world, while in the other, they add a rest of the world sector. The effective misalignment of the renminbi is then calculated to vary between 31 and 45 percent, depending on which of the treatments is used, while the corresponding implied revaluation against the dollar varies from 30 to 59 percent.[17]

For their entry in the BEER approach, Coudert and Couharde (2005) apply a panel-data estimation of the Balassa-Samuelson effect in 21 emerging markets from the first quarter of 1980 to the fourth quarter of 2002. The dependent variable is a real exchange rate index against the dollar. The authors obtain an estimate that China was substantially less misaligned (18 percent undervalued in 2002) than identified in their enhanced-PPP test. They discuss why there is no noticeable Balassa-Samuelson effect at work in China from the first quarter of 1998 to the fourth quarter of 2004, for which they have data, but do not note the obvious candidate: that China's exchange rate policy thwarted adjustment.

Funke and Rahn (2005), like others, start off by noting that the renminbi appears to be highly undervalued on a PPP comparison and that a substantial undervaluation remains after adjusting for the Balassa-Samuelson effect. However, they quickly move on to calculate a BEER and a permanent equilibrium exchange rate, which is a BEER with the independent variables set at their permanent values. They estimated their model on quarterly data for China alone, from the first quarter of 1985 to the fourth quarter of 2002; however, when they discovered a break in the series, they estimated their final model only from the first quarter of 1994 to the

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17. The authors use a higher index for more units of domestic currency per unit of foreign currency, so the estimates they cite for undervaluation are equivalent to percent revaluation implied.

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fourth quarter of 2002. They find that the renminbi was undervalued by only 3 to 6 percent in 2002 on a real effective basis and by 11 to 12 percent bilaterally against the dollar.

The paper by MacDonald and Dias (2007) was presented to the February 2007 workshop at the Peterson Institute on what would be necessary to reduce the global imbalances. The paper aimed to estimate a BEER model and use it to predict which exchange rate changes would be consistent with the three patterns of global current account outcomes. In addition to including the standard productivity variable, but omitting the usual net foreign assets, MacDonald and Dias also included the trade balance (though its coefficient was small), the terms of trade, and the real interest rate, the last of which was insignificant, which is not surprising as real interest rates are now more of a world than a national variable. They calculate changes in the effective exchange rate rather than the dollar rate and again get a wide range, from 8 to 30 percent undervaluation. As the target current account outcomes were suggested by the organizers of the workshop at which the paper was originally presented, the authors should not be held accountable for this wide range of estimates.[18]

Stolper and Fuentes (2007) of Goldman Sachs also presented their paper at the same workshop. They made the point that the implicit implication of the finding of no dollar overvaluation in the Goldman Sachs dynamic equilibrium exchange rate (GSDEER) model is that the US deficit would asymptotically approach a sustainable level at the current exchange rate of the dollar. Hence any renminbi adjustment would permit a depreciation of other currencies, such as the euro, against the dollar. Introducing terms of trade into their model did, however, point to a modest renminbi undervaluation of about 7 percent against the dollar.

Wang (2004) includes a section on determinants of the medium-run path of the real exchange rate in her chapter of an IMF study of the Chinese economy. She estimates an ERER model for China alone using annual data over the period 1980–2003. Her variables include productivity changes, NFA, and openness. She finds that the estimated equilibrium exchange rate was only about 5 percent more than the actual exchange rate in 2003 and concludes that any undervaluation was small.

The salient difference in the BEER group results is between those studies that use international panel data and those that use only Chinese data. The former tend to find much larger estimates of the degree of undervaluation, whereas the latter find only small estimates. In the China-only studies, Wang's finding implies that undervaluation was only about 5 percent greater in 2003 than the average across the estimation period (1980–2003). Even that is surprising, as everyone agrees that the renminbi was severely overvalued in the early 1980s.

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18. In a subsequent letter to the *Economist* (July 14, 2007), the senior author gave a BEER estimate of renminbi undervaluation of 30 percent.

Similarly, the Funke and Rahn finding that undervaluation was modest in 2003 should really be read as a finding that it was only modestly larger than it was over the period 1994–2003 as a whole. What one concludes from BEER models therefore depends critically on whether one uses them to evaluate the path of the real exchange rate over time based on movements that would have been expected from international experience of response to changes in productivity, NFA, and other explanatory variables, or whether one relies exclusively on Chinese experience.

FEER Estimates

The first FEER study listed is that of Anderson (2006), who estimates that the Chinese current account balance was artificially boosted in 2006 by factors such as excess heavy industrial capacity and that the cyclically adjusted current account surplus stood at 5 percent of GDP. The underlying foreign direct investment (FDI) inflow is estimated as 1 percent of GDP, giving a target adjustment of 6 percent of GDP. Applying a model with export elasticities of 0.5 and an import elasticity of 0.8, Anderson estimated that this adjustment would require a revaluation of 18 to 25 percent (undervaluation of 15 to 20 percent). This is subsequently interpreted as appreciation against the dollar in the same range, implying that Anderson does not anticipate that other countries would appreciate against the dollar in response to a renminbi appreciation.

The assumption that the surplus has cyclical causes is crucial because in 2006 the actual current account surplus was 9 percent of GDP, so the target adjustment would widen to about 10 percent of GDP if one did not believe that a cyclical component to the surplus would naturally unwind without currency appreciation. In view of the still larger prospective surplus in 2007—on the order of 11 percent of GDP—it seems difficult to give much weight to the notion that a large portion of the surplus will naturally reverse as the cycle runs its course.[19]

The next two studies in the FEER school are by one of the authors of the present paper (Cline 2005, 2007). The first of these, Cline (2005), studies the optimal way to achieve a target adjustment of the US current account to reduce it to 3 percent of US GDP by 2010. It assumes that, as part of a multilateral adjustment process, the current account surpluses of China and other countries would decline by 40 percent—for China, from 4.2 percent of GDP in 2004 to 2.5 percent in 2010. Cline calculated that this adjustment would require an effective renminbi appreciation of 8 percent from the 2002 level and 21 percent from the March 2005 level, with a corresponding bilateral appreciation of 45 percent against the dollar from the

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19. Goldstein and Lardy (in chapter 1) estimate the 2007 outcome at 11 percent of GDP.

latter base. Cline is like Bénassy-Quéré et al. in estimating simultaneously a set of exchange rates for all of the major economies. His second study, Cline (2007), which was presented at the workshop mentioned earlier, accepts the IMF projection that China's current account is on track for a surplus of 6.3 percent of GDP in 2011 following present trends. Cline interpreted the three objectives he was given by the workshop organizers as being to seek what would be necessary to reduce the current account surplus, first, to 1.7 percent of GDP; second, to zero; and third, to transform the surplus into a deficit of 1.4 percent of GDP. In this study, he estimated the needed remaining appreciation of the renminbi to be in a range of 11 to 18 percent from its 2006 level in real effective terms and 34 to 39 percent against the dollar.

Coudert and Couharde (2005) complete their study with a FEER-type estimate of undervaluation. They do not state explicitly what outcome they expect given present trends, but their calculations are intended to illuminate the revaluation of the renminbi that would be needed, first, to induce a current account deficit of 1.5 percent of GDP, and second, to induce a current account deficit of 2.8 percent of GDP. They obtain corresponding estimates of 23 and 30 percent, respectively, for undervaluation of the effective exchange rate and 44 and 54 percent, respectively, for the dollar rate.

Goldstein (2004) uses the underlying balance approach to estimate a FEER for the renminbi. He takes a net capital inflow of 1.5 percent of GDP as normal, and therefore assumes that China should target a current account deficit of that size. He estimates that China had a normal current account surplus of 2.5 percent of GDP, implying the need for an adjustment of 4 percent of GDP. He states that a "small, bare-bones, elasticity-based trade model" (that was nonetheless sufficiently sophisticated to recognize that the answer needs to reflect China's important role in processing intermediate goods for assembly) implied a need for a renminbi appreciation in the upper half of a 15 to 30 percent range (Goldstein 2004, 201). Goldstein appears to have been thinking of an effective appreciation of that size, though this is not explicit. He also presents an analysis based on the need for global payments adjustment, in which he argues rather informally that the Chinese adjustment just advocated would be consistent with the needs of the global economy.

Goldstein and Lardy (2006) adopt a similar approach, though with a little more history behind them. They argue that the underlying Chinese current account surplus in 2005 was in the range of 5 to 7 percent of GDP (against their predicted 2005 actual outcome of 7 to 9 percent, which reflected somewhat slower domestic growth and some real appreciation in 2005). The bare-bones elasticity model now gave them answers in the upper part of a 20 to 40 percent range. Although this may seem a rather modest response to an increase of at least 2.5 percent of GDP in the need

for adjustment, the final figure is consistent with the elasticities and current account response suggested in the first section of the present paper.[20] A footnote in Goldstein and Lardy (2006) gives a range of 20 to 35 percent effective undervaluation, taking a broad view across several methodologies: This is stated in table 4.1 of the present paper as their estimate. However, Goldstein and Lardy (2006) are quite unambiguous in speaking of an undervaluation of the effective rate.

Goldstein and Lardy (in chapter 1) raise their previous estimate of needed appreciation to eliminate undervaluation to a range of 30 to 55 percent. Once again their framework is the elasticity approach. They place the range for the parameter relating real exchange rate change to current account change at 2 to 3.5 percent of GDP adjustment for a 10 percent real exchange rate change. This range results from applying the parameter range to an 11 percent current account surplus for 2007 and, by implication, assumes that no part of the surplus is cyclical and likely to decline without a change in the exchange rate.

Jeong and Mazier (2003) also aim to calculate FEERs in a model comprising China, Japan, Korea, the United States, Euroland, and the rest of the world. They estimate the influence of various variables (e.g., FDI, demographics, and income) on the current account balance for industrial countries and emerging markets separately, then estimate from those variables the equilibrium current account for each country in the model. Internal balance is estimated by the Organization for Economic Cooperation and Development approach—or, in the case of China, by a Hodrick-Prescott filter.[21] Like Coudert and Couharde, Jeong and Mazier do not state explicitly a figure for the underlying current account surplus but calculate what would be necessary to induce a deficit of 1 to 1.5 percent of GDP. The exchange rate that would reconcile internal and external balance is compared graphically with actual exchange rates. The graphs (Jeong and Mazier 2003, 1177) indicate that by 2000, the final year in the estimates, the actual REER was 22 percent below the equilibrium level, indicating 29 percent needed appreciation, and the bilateral rate against the dollar was correspondingly undervalued by 40 percent, indicating a 67 percent needed appreciation.

In addition to a BEER model, Stolper and Fuentes (2007) estimate a supplementary elasticities (i.e., FEER) model. The results suggest that the US dollar needs to decline by about 15 percent; China would be expected to play a proportionate part.

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20. The Goldstein-Lardy implicit parameter of 0.25 percent of GDP reduction in current account surplus for a 1 percent rise in the real exchange rate is virtually the same as suggested in note 13 above.

21. The first measures capacity by connecting cyclical peaks in output over time; the second generates a smooth nonlinear representation of the time series.

Exploring the macroeconomic balance approach to supplement her BEER approach, Wang (2004) estimates the underlying Chinese current account balance as a surplus of 2.1 percent of GDP and contrasts it with, first, a target surplus of 3.1 percent of GDP, which she estimates as appropriate based on savings and investment, and second, a surplus of 1 percent of GDP, which would stabilize the NFA to GDP ratio at its 2001 level. These targets would require a small depreciation or a small appreciation, respectively, of the effective rate of the renminbi (these conclusions are interpreted as changes of 0 to 5 percent in table 4.1).

The last study listed in table 4.1 is that of Simon Wren-Lewis (2004), which employs a FEER-like approach: He uses a global model that calculates the bilateral exchange rates that would produce target current account outcomes in equilibrium and undertakes a special extension to estimate renminbi values consistent with various current balance adjustments. Wren-Lewis estimates that China had an underlying current account surplus equal to 3.4 percent of GDP in 2002. To reduce this to a 1 percent surplus would have required a bilateral appreciation against the dollar of 19 percent. Eliminating the surplus entirely would have required a 22 percent appreciation.

It should be emphasized that most of the above estimates were calculated between 2000 and 2005, when China's current account surplus averaged 3.2 percent of GDP. With a surplus almost four times this large in 2007, the magnitude of undervaluation appears to be larger today. It should also be stressed that the studies that attribute a large part of China's surplus to temporary cyclical factors raise special questions. It seems increasingly implausible that China's underlying current account surplus after removing cyclical factors is only 2.1 percent of GDP (Wang 2004) or 5 percent (Anderson 2006; Goldstein and Lardy's low alternative), and thus, that the great bulk of today's much larger surplus can be expected to disappear naturally without exchange rate appreciation as the business cycle runs its course.

Probably the major source of discrepancies among the FEER estimates is the studies' assumptions about how large a change in the current account of the balance of payments should be targeted. A key source of diverging adjustment targets is differences in identifying whether the present level of the current account represents a longer-term trend or is temporarily exaggerated. After that come different assumptions about the price elasticities of demand, including assumptions about the import content of exports.

Most of the FEER estimates suggest a widespread judgment that an appropriate target for China is a current account outcome that is not enormously different from a balanced current account. The biggest surplus is one of Wang's targets, rationalized by China's high saving propensity. The next largest is one of Cline's targets, which resulted from a desire to

treat all surplus countries equally rather than a belief that it is in China's national interest to export real resources.[22]

Wang's view implicitly assumes that world welfare is maximized by allowing countries that wish to save in excess of the level of investment that is efficient at the world interest rate to do so and export the resulting savings as a current account surplus. The counterargument is that such a view assumes, first, that a national government's decision should be accepted uncritically as the judge of what is in the social interest of its citizens, and second, that there is no problem of world consistency of current account objectives that needs to be dealt with.

Regarding the first point, there are still about a hundred million desperately poor people in China, who save a lot partly because much of the saving is corporate and is not their decision at all and partly because they are afraid of the future because of the lack of a safety net. The international community should take their interests into account even if China's government ignores them. If one holds such a view, then a current account close to balance seems to be a more natural target than is a large surplus. China's policy should aim to reduce the saving rate, as indeed it does, at least in theory. We do not attempt to deal with the second problem here.

Another obvious source of differences in FEER estimates lies in differing assumptions about trade elasticities.[23] Anderson (2006) uses an export elasticity of 0.5—which he asserts is probably too high—and an import elasticity of 0.8. Cline (2005, 2007) assumes that all price elasticities, both of exports and imports, are of unity. Coudert and Couharde (2005) take their elasticities from the NiGEM model, in which all elasticities satisfy the Marshall-Lerner condition (though in the case of the United States they only just satisfy it) and vary from 0.50 to 1.19 for the export price elasticity and from 0.41 to 0.95 for the import price elasticity. Neither Goldstein (2004) nor Goldstein and Lardy (2006) state their assumed elasticities but do state that they are conventional. Jeong and Mazier (2003) also take their elasticities from other models with specifications similar to their own, and compare the estimated elasticities from different models. Wren-Lewis (2004) uses export price elasticities of 2 and import price elasticities of 0.5.

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22. His largest deficit target is one suggested by Williamson and a coauthor, in a period when it was widely held that developing countries ought to be importing real resources and there was little concern about having a competitive exchange rate.

23. One study not included here that investigates the impact of variations in the trade elasticities is that of Dunaway, Leigh, and Li (2006). Their estimates of the impact of increased export and import elasticities from 1 to 1.5 are interdependent with those of the current account adjustment to be accomplished: If this is only 1 percent of GDP, lower elasticities would increase undervaluation by about 4 percent, whereas with a gap of 3 percent of GDP, the impact on undervaluation would be about 13 percent. The difference is substantial.

Figure 4.3 Real renminbi appreciation needed to eliminate undervaluation

a. Enhanced PPP (bilateral against dollar)

percent
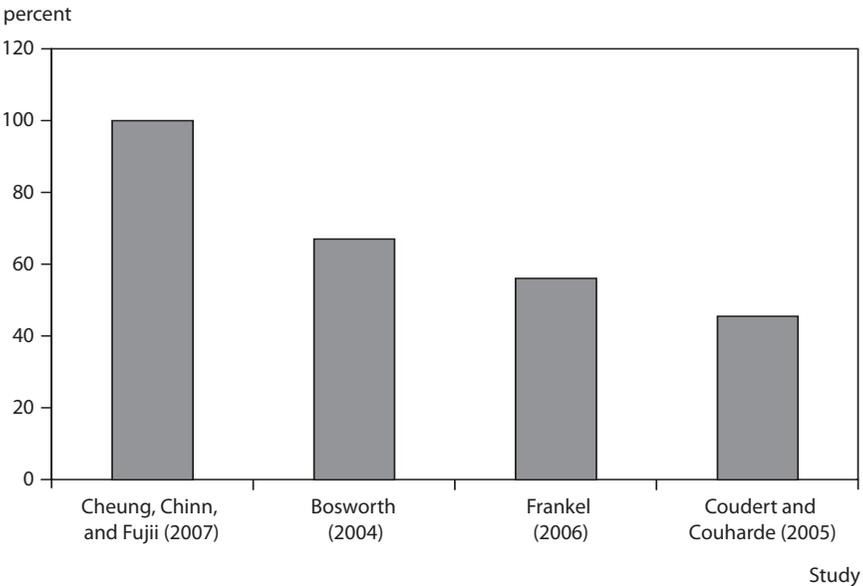
*(figure continues next page)*

Conclusion

Figure 4.3 summarizes the estimates in table 4.1, which are grouped by each of the three approaches above, showing multilateral and bilateral estimates separately.[24] For studies showing a range, the figure shows the midpoint. The studies are ordered by descending magnitude of estimated misalignment within each approach. It is evident that the largest undervaluations are found in the enhanced-PPP estimates.[25] The simple average for the four enhanced-PPP studies is a needed real appreciation against the dollar of 67 percent for the renminbi, whereas the simple averages for bilateral real appreciations given by the BEER and FEER approaches are smaller, at 25 and 36 percent, respectively. The simple averages for the multilateral real revaluations in the BEER and FEER approaches are even more moderate, at 18 and 20 percent, respectively. Also, as figure 4.3 shows, there is considerably more agreement among the enhanced-PPP

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24. None of the enhanced-PPP estimates include multilateral realignment, so all are treated as bilateral.

25. The Big Mac simple PPP is excluded as conceptually flawed.

Figure 4.3 Real renminbi appreciation needed to eliminate undervaluation *(continued)*

b. Behavioral equilibrium exchange rate (BEER) and fundamental equilibrium exchange rate (FEER)

Real effective exchange rate

Bilateral dollar rate
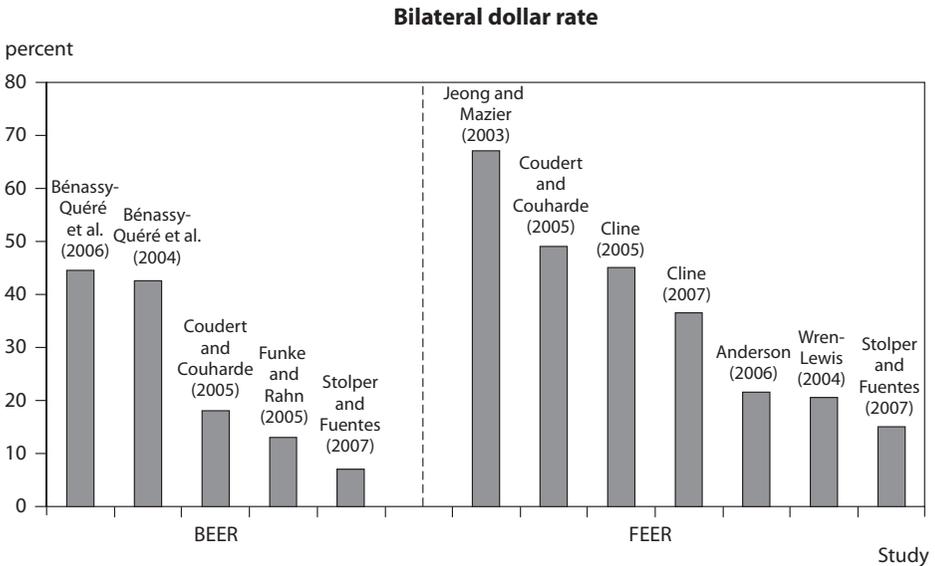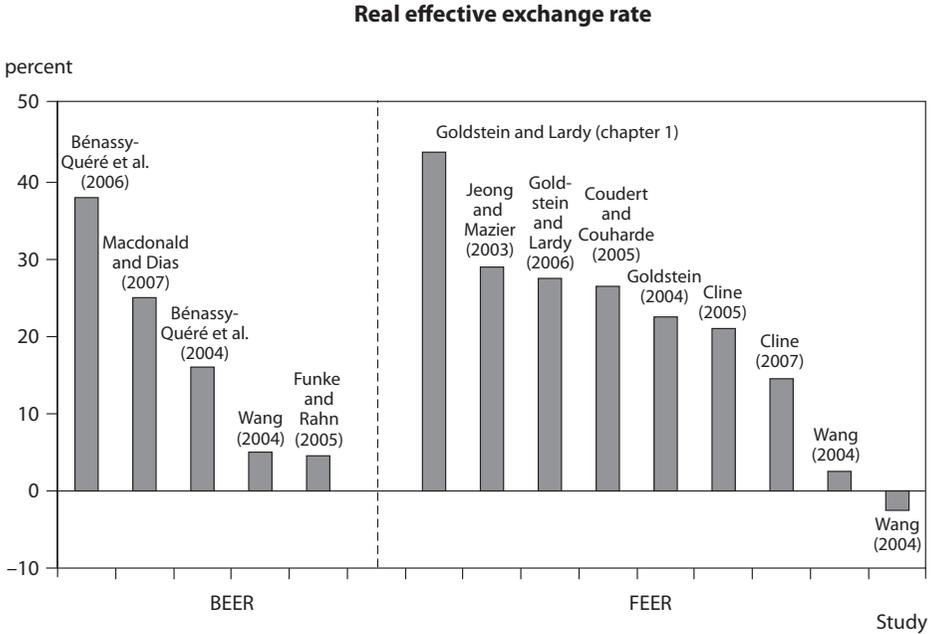
Source: Table 4.1

estimates than among the BEER estimates. The FEER estimates also show more agreement than do the BEER estimates if the two outliers proposed by Wang (2004) are excluded.

It seems highly likely that the enhanced-PPP estimates overstate the needed degree of appreciation for China. New World Bank estimates that became available subsequent to this conference, based on International Comparison Program surveys that for the first time directly included China, sharply reduce the ratio of the PPP exchange rate to the market rate, confirming suspicions that the ratio had been exaggerated by erroneous estimation of China's price level and broadly superseding the PPP studies surveyed here. More generally, although the approach relies on a robust empirical generalization about the ratio of the PPP exchange rate to the market rate, it does not estimate what one is conceptually seeking to measure. Even using only the data available before the 2007 World Bank results, the enhanced-PPP approach shows chronic undervaluation for China going back a quarter century, whereas policy concerns about undervaluation have escalated only in recent years.

Among the BEER approaches, the two based purely on Chinese data (Funke and Rahn 2005, Wang 2004) suggest a much smaller undervaluation, but intervention to prevent appreciation may have made them misleading. BEER approaches that use cross-sectional panel data show a much larger degree of undervaluation, similar to that suggested by the FEER approach. The average in figure 4.3 excluding China-only estimates is a 23 percent needed appreciation in the real effective multilateral rate, and 32 percent bilaterally, against the dollar. Thus, under the BEER approach, the renminbi seems to be substantially undervalued by normal international standards.

Attempts to measure a FEER assume that one is seeking a normative measure of undervaluation. FEERs depend primarily on the target current account that is fed into them as an objective. The view that China should aim for a large current account surplus because it has a high saving rate is acknowledged, but it is argued that a normative exercise should not automatically accept the government-stated social objective but should ask whether phenomena such as China's high saving rate are calculated to maximize social welfare. When this is done, an objective in the vicinity of zero surplus—similar to the objectives of most of the FEER exercises—seems reasonable. Among the FEER estimates, we consider the Wang (2004) calculations seriously understated because they assume that China's cyclically adjusted current account surplus is running at only 2 percent of GDP rather than the actual 9 percent in 2006 and 12 percent in 2007. Excluding these two estimates, the average for the FEER estimates in figure 4.3 is a needed appreciation of 27 percent in the REER, close to the international BEER estimates, and 36 percent in the bilateral exchange rate.

Because of its underlying fragility and likely bias in past Chinese price comparison estimates, we consider the estimates in the enhanced-PPP

school to be unreliable. In contrast, the BEER estimates using cross-country data and the FEER estimates using plausible cyclical components of the current account surplus arrive at the same range of renminbi undervaluation, with about 25 percent real effective appreciation needed to remove undervaluation in both sets of estimates.

Methodologically, we prefer the FEER approach because the necessary assumption of average equilibrium over the estimation period makes even the internationally based BEER approach less reliable. Within the FEER school of estimates, the main need seems to be to work toward agreement on, first, how much of China's current account surplus is underlying and how much is temporary, and second, what magnitude of surplus (if any) makes sense over the medium term. On the latter issue, it is highly likely that most analysts, as well as the Chinese authorities themselves, would agree that the medium-term current account surplus should not be anywhere near double digits as a percentage of GDP. The needed correction is thus at a minimum several percentage points of GDP.

Finally, it should be reiterated that most of the studies surveyed in this chapter were conducted using the lower earlier levels of the current account. If there have been structural changes toward a current account surplus, the needed real effective appreciation could be larger than the roughly 25 percent real effective range suggested by the international-BEER and most of the FEER studies. For example, using the parameter suggested both here and in Goldstein and Lardy (chapter 1) that a 10 percent real exchange rate change with supporting expansion of internal demand leads to a change of about 2.5 percent of GDP in the current account, complete elimination of the 2007 surplus could require as much as a 43 percent real effective appreciation. However, it seems likely that a significant part of the surplus is cyclical. In particular, application of the same parameter to the effective real depreciation of the renminbi in recent years cannot explain the full surge in the surplus.

The IMF and the Bank for International Settlements place the real effective depreciation of the currency from 2002 to 2006 at 8 percent, deflated by consumer prices. The decline reflects the renminbi riding the dollar down. If one adopts the Goldstein-Lardy argument of additional productivity influences and places the relative price change for China's exports from 2002 to 2006 at zero (rather than the cumulative consumer price inflation of 8 percent) over these four years, then real effective depreciation would have been about 16 percent. But applying the parameter above would then have implied a rise of the surplus by 4 percent of GDP, not 9 percent of GDP (the increase from 2003 to 2007).

Anderson (2006) suggests that excess capacity in heavy industry following unusually large investment spurred atypical exports in 2005 and after, indicating one possible source of temporary exaggeration of the surplus this year. As a consequence, whereas some of the studies surveyed in this study using data before 2004 may have understated the extent of ex-

change rate correction needed by 2007, applying a FEER approach to the full magnitude of the 2007 surplus rather than an adjusted estimate would likely overstate the correction needed.

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Comment
Equilibrium Exchange Rate
of the Renminbi

JEFFREY A. FRANKEL

William Cline and John Williamson have performed a timely and useful service in providing a well-executed survey of recent estimates of the proper value of the renminbi. The literature is by now large enough to merit a survey, and the topic remains one of the hottest policy questions of international finance in recent years. The width of the range of estimates is an appropriate subject of consideration in its own right: The failure of experts to come to even a rough consensus on whether a currency is undervalued or overvalued calls into question giving the International Monetary Fund (IMF) or the US Treasury legal mandates to assess the correct value and to levy penalties if corrections by the erring government are not forthcoming.

A Technical Point

At the risk of sounding too professorial, I begin with a technical point. Table 4.1 and the rest of the Cline-Williamson paper generally report the percentage appreciation needed to eliminate undervaluation, as distinct from percentage undervaluation. I feel strongly that all of these numbers ought to be converted to logs. I understand fully that saying the word

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Jeffrey A. Frankel is James W. Harpel Professor of Capital Formation and Growth at Harvard University's Kennedy School of Government.

"logarithm" in a congressional hearing will probably clear the room faster than an anthrax scare. But in academic papers we do it in logs. My judgment is the Peterson Institute should do it in logs as well. My recommended phrasing is "the percentage undervaluation of the renminbi is estimated at X percent," followed by the word "logarithmically," either in parentheses or in a footnote.

Even judged purely from the standpoint of user-friendliness to nonspecialists, my recommended phrasing is likely to be less confusing than the repeated practice of reporting two numbers, one for percentage undervaluation (say, 50 percent) and another for required appreciation to return to equilibrium (100 percent), which causes the uninitiated reader to wonder why on earth the two numbers are not the same. For example, the authors correctly report both my estimates that the renminbi was 36 percent undervalued relative to the average normal Balassa-Samuelson relationship and that a 56 percent revaluation would be required to reverse it. Citing both numbers seems potentially confusing to noneconomists. Better to emphasize the single log number, as I do (45 percent), which represents both the percentage undervaluation and the percentage appreciation that would be needed hypothetically to reach long-run equilibrium. The authors' choice of reporting percentages can also make the numbers sound large (e.g., "100 percent" rather than "50 percent").

Approach 1: Purchasing Power Parity (PPP)–Enhanced by Balassa-Samuelson

Cline and Williamson label the first category of techniques for estimating the value of the renminbi as the enhanced-PPP approach, which computes absolute PPP for individual countries relative to the Balassa-Samuelson line, that is, relative to the usual relationship under which the real exchange rate, on average, rises with the level of productivity or real income—across countries but also across time. The authors are skeptical of the enhanced-PPP approach. Some of their concerns are justified, but not all.

One place where Cline and Williamson have a good point is that many of the calculations of overvaluation, including my own, have been made relative to the dollar. But this approach neglects the possibility that the dollar itself is over- or undervalued. It is better to calculate the overvaluation of the renminbi relative to a weighted basket rather than relative to the dollar alone. But nothing in the enhanced-PPP approach prevents this.

Another place where I agree with them is in their judgment that the most recent enhanced-PPP study by Cheung, Chinn, and Fujii (2007), though otherwise excellent, does not use the most appropriate standard errors and thereby conveys less confidence in their own estimates than is merited. The Balassa-Samuelson relationship itself is highly significant sta-

tistically, and so it is appropriate to conclude that large deviations from it are significant.[1] China may not quite make it into the 5 percent of currencies most out of line by the Balassa-Samuelson criterion, as the Cheung, Chinn, and Fuji application of a 95 percent confidence criterion apparently requires, but this should not preclude us from saying that the calculation shows that it is undervalued.

Most important, Cline and Williamson question the reliability of the Chinese price data in the Penn World Tables (PWT), which are the basis for the absolute-PPP calculations, specifically suggesting a downward bias (Keidel 1994, Summers and Heston 1991). They make an excellent point that such measurement errors, to the extent they are important, distort not only the variable measured on the vertical axis of the Balassa-Samuelson relationship but also the real income or productivity measure on the horizontal axis. The possibility that the PWT data were subject to measurement error, and that this might be especially true of the data for China because of a paucity of genuine within-country data, has long been evident. In the past, little information has been available on why the measurement errors for China should be strongly biased in a particular direction, as the authors assert.[2]

Several weeks after the Peterson Institute conference that led to this volume, however, the authors were proven spectacularly right when the Asian Development Bank (2007) and the International Bank for Reconstruction and Development (IBRD 2007) released the preliminary results of a new study of absolute PPP. This study, under the International Comparison Program (ICP), used much more extensive data, in particular for China, than had previously been available. According to the new numbers, which pertain to 2005, China's price level is 42 percent of the US price level. This is far less of an undervaluation against the dollar. The new numbers also show China's real income per capita to be 9.8 percent of the US level. Using estimated Balassa-Samuelson coefficients from either Rogoff (1996) or Frankel (2006)—0.37 or 0.38—this implies that the appropriate long-run equilibrium real exchange value for the renminbi is 42

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1. I say as much in my own comment on the paper by Cheung, Chinn, and Fujii (Frankel 2008).

2. I was not particularly persuaded, for example, by an argument of the authors that seems to be circular: "It is also well known that China is an extreme outlier, with low domestic prices. The presumption is thus that China's prices have been measured unreliably at below actual levels." Perhaps we should grant Cline and Williamson extra credibility on this claim in that it runs counter to the claims of their colleagues at the Peterson Institute that the renminbi is undervalued. See C. Fred Bergsten, Testimony before the Hearing on US-China Economic Relations Revisited, Committee on Finance, United States Senate, March 29, 2006; Morris Goldstein, "China's Exchange Rate Regime," Testimony before the Subcommittee on Domestic and International Monetary Policy, Trade, and Technology, Committee on Financial Services, US House of Representatives, October 1, 2003; Morris Goldstein and Nicholas Lardy, "Two-Stage Currency Reform for China," *Wall Street Journal*, September 12, 2003. See also Goldstein (2004) and Goldstein and Lardy (2005).

percent of the US price level.[3] In other words, by these calculations, the renminbi is exactly where it should be vis-à-vis the dollar.

Three qualifications are necessary, each suggesting some remaining undervaluation. First, as Cline and Williamson point out, there is no guarantee that the dollar is not itself overvalued or undervalued. By the PPP criterion, it is probably by now undervalued globally, particularly when one includes the depreciation of 2007, which would imply that the renminbi is too.[4] Second, because the new ICP numbers on prices and real incomes are both more up-to-date and more reliable than those previously available, it makes sense to reestimate the Balassa-Samuelson estimation. Arvind Subramanian has done this, and he computes that the renminbi is still 15 percent below where it ought to be. Third, the price data for China might not account sufficiently for the effect of lower prices in rural districts, which would again imply that the renminbi is more undervalued than the latest numbers suggest. Certainly, however, the new ICP numbers imply that the renminbi is far less undervalued under the extended-PPP approach than we had previously thought.

I am less convinced by the authors' remaining two critiques of the enhanced-PPP approach.[5] They say (chapter 4, 135), "There is ample historical experience (including that of China today) to show that the deviation of the PPP/market exchange rate ratio (PPP/er) from the international norm can be a wholly misleading guide as to whether the country has a current account surplus or deficit. . . ." I cannot think of anyone who claims that this ratio is a reliable guide to whether a country is in surplus or deficit, so I do not see how it can be misleading. The authors point out that China established large trade surpluses only in the last five years, whereas the renminbi has been "undervalued" on the enhanced-PPP basis for a lot longer: "The enhanced-PPP approach seems to show chronic undervaluation for China going back a quarter century, whereas policy concerns about undervaluation have escalated only in recent years" (chapter 4, 151). I hope we are not going to use as the economic criterion for over-

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3. To say that Chinese income is 9.8 percent of US income is to say that there is a gap of 2.32 in log terms. Multiply by 0.37 or 0.38 to get the estimate that the price level gap should be 0.87 in log terms—i.e., that the Chinese price level should be 42 percent of the US price level.

4. Relative to developing Asia, Chinese prices are an estimated 3 percent above average, according to the Asian Development Bank (2007). China's income is 14 percent above the average for developing Asia, which implies that its prices should be 5 percent above the Asian average. By this calculation the renminbi is undervalued by a mere 2 percent relative to the Asian average.

5. It may sound like I have just agreed with three out of five of the authors' critiques of enhanced-PPP as a methodology. But the third point was merely a critique of the numbers available before 2007. Now that we have the new absolute-PPP numbers from the ICP, the enhanced-PPP approach is more useful.

valuation whichever country politicians choose in any particular decade as the scapegoat for US deficits or other escalating policy concerns.

The most natural explanation for China's large trade surplus is that this has been a period in which previously high trade barriers between China and the rest of the world have come down, most conspicuously as China has joined the World Trade Organization and the West has dropped barriers including the Multi-Fiber Arrangement and the earlier quasi-sanctions that the United States arrayed against China, such as the annual dangling of renewal of most favored nation or normalized trading relations status. The combination of tumbling barriers and a substantial pre-existing cost advantage explains the rapid increase in China's trade balance. An equally important part of the story is China's extraordinarily high saving rate.

The authors' example of Japan perhaps gives one more genuine cause for worry (especially figure 4.2). How can Japan have consistently run such large current account surpluses in recent decades even though its currency has been greatly overvalued—more so in 1995 than in 1985 or today—relative to the Balassa-Samuelson relationship? One possible answer is that the Balassa-Samuelson relationship applies more strongly to Japan than to other countries: The rate of growth of productivity in traded goods and the rate of increase in the relative price of nontraded goods have both been higher in Japan over the postwar period than would typically be implied by its rate of growth of real income. Still, their point is a good one.

The authors' fifth criticism of the enhanced-PPP approach is that it is not suited to normative statements. The public wants an estimate of how much China should revalue, preferably right now. I certainly did not intend for my estimate of a 45 percent undervaluation relative to the Balassa-Samuelson relationship to be interpreted as a statement that the currency should be revalued by anything like that in a short period. I moved closer to a normative argument with the following logic. According to my estimates, from one decade to the next, the typical country closed almost exactly one-half of its deviation from the Balassa-Samuelson relationship. That alone would be sufficient to produce an estimate that the renminbi would appreciate at 22 percent over the next ten years, or 2.2 percent per year.

But in addition, we expect China to continue to experience higher productivity growth than its trading partners. Assuming that China's growth continues on the order of 6 percent greater than US growth, the standard Balassa-Samuelson effect, which is a movement along the curve rather than to the curve, would require adding another 2.3 percent of real appreciation per year, or 0.38 times the relative growth rate. The total is a predicted rate of real appreciation of 4½ percent per year. My prescriptive conclusion was that it would be better to take this real appreciation in the

form of nominal appreciation rather than build in an inflationary bias (above the world rate) of this magnitude.[6] These numbers now need to be substantially revised in light of the new price numbers released in December 2007 by the International Comparison Program of the World Bank.

Approach 2: Exchange Rate Equations

Cline and Williamson next look at behavioral equilibrium exchange rates (BEER). I agree with their identification of the shortcomings of these approaches, in the present context, which is that they can only deliver a statement about the valuation of a given currency today relative to its own past history. As with the simpler relative-PPP calculations, one needs to be able to assert that there was a particular year when a currency was in equilibrium, or else assert that it was in equilibrium, on average, during the sample period.[7] I do not think this approach will work for China because the hypothesis—my hypothesis, anyway—is that the renminbi may have been undervalued for a long time, at least as long as the period for which it has had the semblance of a market economy.[8] Particularly for the study that allows a break at the time of the Chinese devaluation (unification) in 1994, I do not see how one can presume that the post-1994 period was properly valued on average. The hypothesis under consideration is that the currency has been undervalued throughout this period. One cannot test a hypothesis by means of an assumption that rules out the hypothesis a priori.

MacDonald and Dias (2007) do not get a significant effect on the real interest rate. I am surprised to read the authors explain this on the grounds that "this is not surprising since real interest rates are now more a world rather than a national variable" (chapter 4, 143). It is very clear in theory and practice that even if capital mobility is perfect and domestic and foreign assets are perfect substitutes, it only implies uncovered interest parity, not real interest parity. As a result, the real interest differential should be an important determinant of countries' exchange rates, as it is in Dornbusch overshooting.[9] In the case of China, I agree that the lack of an effect

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6. As McKinnon (2006) and McKinnon and Schnabl (2003) have emphasized repeatedly, to build in a trend of real appreciation of 4½ percent per year is eventually to build in real interest rates 4½ percent below world levels, which is not desirable. For this reason, I would favor an abrupt nominal revaluation of, perhaps, 10 percent in the first year.

7. "This is only as good as the assumption of an equilibrium average real exchange rate over the sample period" (chapter 4, 137).

8. I would like to hear the authors elaborate on their statement that "everyone agrees that the renminbi was severely overvalued in the early 1980s" (chapter 4, 143). I suspect that it depends on one's definition of overvaluation.

9. See Dornbusch (1976) and Frankel (1979). A recent example for a financially open emerging-market currency is Frankel (2007).

is not surprising but for the opposite reason: China retains important capital controls and domestic interest rates are not yet fully market determined. In other words, financial liberalization has been too little, not too much, to see this effect show up. That said, I share the authors' bottom line that "the necessary assumption of average equilibrium over the estimation period makes even the internationally based BEER approach less reliable" (chapter 4, 152).

Approach 3: Fundamental Equilibrium Exchange Rates (FEERs)

The third approach is FEER, which is, of course, the authors' own preference. Although John Williamson has made us familiar with this approach over the years, their definition somehow still surprises me (chapter 4, 138): "The basic idea is to search for a set of exchange rates that will simultaneously achieve internal and external balance in every country (Meade 1951)." But I would have thought it a basic proposition, of Meade in particular, that exchange rates are not in themselves sufficient to achieve simultaneously internal and external balance. The Tinbergen-Meade principle is that if one has N policy goals, one must have at least N independent policy instruments. Because countries have goals for both internal and external balance, they need a second policy instrument in addition to the exchange rate: in Harry Johnson's classic terminology, an expenditure-reducing instrument, such as monetary or fiscal policy. Perhaps Cline and Williamson dismiss the internal balance consideration because, as they state (chapter 4, 138), "In an era when long-run Phillips curves are widely believed to be vertical . . . there is not much room for arguing about levels of internal balance." If so, I disagree. They seem to think that agreeing on where the desirable point of external balance lies is the main issue of difficulty. I believe that deciding where internal balance lies is at least as difficult as deciding where external balance lies.

Admittedly, there is also a wide range of disagreement about external balance. On the one hand, Dooley, Folkerts-Landau, and Garber (2004, 2007) believe that China is deliberately keeping its currency undervalued as part of an intelligent development strategy. Some of my colleagues believe that other countries should do the same (e.g., Rodrik 2007), while others have said that it makes perfect sense for the United States to run a current account surplus due to its comparative advantage as the world's banker (e.g., Caballero, Farhi, and Gourinchas 2006). In other words, one view is that external balance for China implies a trade surplus. On the other hand, as the authors point out, the traditional view is that a poor country with a low capital-to-labor ratio—or a country that is rapidly and successfully developing—ought to be importing net capital inflows from abroad, which means running a trade deficit. My own view is somewhere

in between. The choice is arbitrary, but zero surplus or deficit is perhaps as good a number as any (under the Polonius principle, "neither a borrower nor a lender be").

The question of external balance is indeed hard to settle convincingly, but so is the internal balance question. The difficulty in choosing optimal targets for either external or internal balance in a way that convinces a majority of reasonable economists is the prime reason why I have long felt that there are limits to the practical usefulness of the FEER approach developed by my beloved friends at the Peterson Institute. Indeed, it is part of why there are limits to the practical usefulness of any attempt to say what the correct values of most currencies are. I see the renminbi as a rare exception, in that almost all of the different criteria that one might apply, even if one limits the list to those from the perspective of domestic Chinese interests, happen to have pointed toward the same direction in recent years.

Cline and Williamson indirectly address the issue of internal balance when they talk about cyclically adjusted trade balances. But the issue requires much more discussion. First, one must be explicit about the distinction between the appropriate exchange rate conditional on current spending and the appropriate exchange rate conditional on an assumed change in spending policy that would permit the restoration of internal and external balance simultaneously. This would make a huge difference in some contexts, such as that of the United States. My view is that the dollar is not necessarily overvalued currently if one takes the current trajectory of budget deficits and low national saving as given—quite relevant in that the George W. Bush administration has been unwavering in its commitment to tax cuts despite the resultant deficits. However, the dollar is clearly at too high a level if the standard of comparison is what would be appropriate if one were free to adjust fiscal policy and other settings as part of an overall package of orderly adjustment.[10]

Second, although it is much less clear that China's spending policies have tended too far in one direction or the other over the last couple decades than is the case with the Unites States—China was suffering from deflation in 2001—I believe that China has crossed the internal balance line in the past few years, and is now on the "excess demand" side. The Chinese private saving rate is extremely high, and I agree with Cline and Williamson that one should not presume that this is necessarily optimal. But its investment level is also very high. A growth rate in excess of 11 percent, the reaching of chokepoints and bottlenecks, rising inflation—particularly in food and raw material inputs—and a bubble in the Shanghai stock market all point to excess demand rather than excess supply.

Thus if one cyclically adjusted China's trade surplus, it would look even larger than it does today. The authors do not even seem to consider this

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10. This position is the same that I had in 1983–84 (see the *Economic Report of the President 1984*) and should not be an unfamiliar one—e.g., it is consistent with that of Paul Krugman in an old debate with Ron McKinnon.

Figure 4.C1 Choosing policy settings to attain internal and external balance
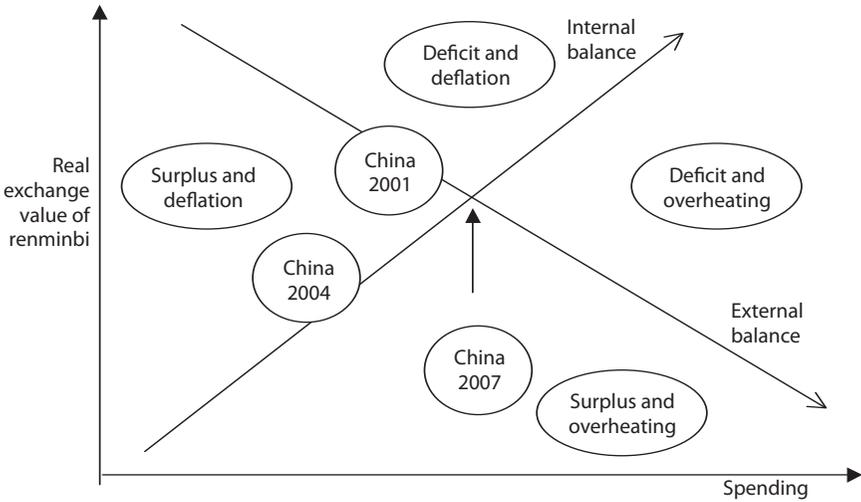
Note: Real exchange value of renminbi is defined, for example, as the relative price of nontraded goods ($P_{NTG}/\$P_{TG}$).

possibility; instead, they cite others' estimates as to how much cyclical adjustment would reduce China's trade surplus (". . . it is necessary to determine how much of the present current account divergence from target is strictly cyclical and transitory, a step that turns out to be critical for China" [chapter 4, 139]. Apparently, Jonathan Anderson believes there is excess heavy industrial capacity, and many others as well are cited implicitly as presuming that China is on the excess supply side of internal balance. The authors themselves agree. This seems to me out of date.) Thus even if one accepts the methodology that implicitly assumes that spending policies are adjusted at the same time as the exchange rate, one will get very different numbers for the recommended revaluation depending on one's estimates of the needed adjustment in spending policies.

Apparently, Cline and Williamson feel that the range of possibilities runs roughly between the areas that I have labeled China2001 and China2004 in figure 4.C1. In that case, when trying to decide which exchange rate change would restore external balance, it makes a huge difference, first, whether one thinks of the question as predicated on the current level of spending. At China2004 it would imply an appreciation, but at China2001 it might not. Furthermore, if one assumes that an appropriate change in spending policy is part of the adjustment process, then China2001 would actually imply a devaluation, but China2004 would imply a small revaluation, whereas China2007 would imply a substan-

tially larger revaluation. My own view is that China over the last four years has crossed over to the vicinity of the area I have labeled China2007. If so, then only a revaluation is needed, roughly speaking, to return to both external and internal balance.[11] But most of the time, the answer depends on whether or not one takes internal balance as given.

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11. I certainly do not mean to imply that revaluation of the currency is the only policy change China should make. Rather, appreciation should be part of a broad strategy of more fully developing the domestic economy—e.g., health care and other services, retirement plans, social safety nets, infrastructure, and environmental protection. My point is only that it is not clear to me that a large overall monetary and fiscal expansion should be part of the package.

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Comment
Toward a Balanced Approach

SIMON JOHNSON

Bill Cline and John Williamson have produced a comprehensive and clear survey of methods used to assess China's exchange rate. It is no surprise to find, once again, that the Peterson Institute is at the forefront of exchange rate analysis and, in this key analytical and policy context, providing sensible and compelling assessments of the various methods used to determine whether and to what extent China's exchange rate is undervalued.

It is also most useful to be reminded that, while no one method always and everywhere dominates in thinking about exchange rate values, a balanced approach using two or three reasonable methods can move us a long way in the right direction. We may not be able to set a precise numerical value for misalignment, but we can find a range of plausible estimates.

I expect that the Cline and Williamson paper will be highly influential, particularly as academia, the private sector, and officials start seriously rethinking exchange rate valuation more generally. There is already a renaissance in substantive research in this area—with real and immediate policy impact—and a user's guide to what is already available and what remains to be done is most helpful.

I strongly encourage Cline and Williamson to package their insights here, together with their other broad and high-impact work on this topic, into an easy-to-use analytical tool to help a wide range of users think through the key concepts. I would also make three fairly modest sugges-

Simon Johnson is economic counselor and director of the Research Department at the International Monetary Fund.

tions as the authors further develop the Peterson Institute's influential thinking on exchange rates.

First, Cline and Williamson could be a bit more forthright in their judgments regarding the advantages and disadvantages of each method. There is plenty of content and nuance in the authors' assessments, but I was hoping for some bluntness as well, ideally even a letter grade ranking the implementation in various approaches.

In particular, while purchasing power parity (PPP)–based methods have their attractions in some contexts, they are most dubious when applied to China precisely because until December 2007, there were no real comparable price data for China. Currently, we have actual survey-based price data, but these should presumably also be handled with caution, as they are quite new. In addition, the theoretical link from the PPP approach to external stability needs much more elaboration if it is to stand shoulder to shoulder with methods that have much stronger analytical underpinnings. Hopefully, the authors can reassess the existing PPP studies covered in their paper to determine how the results change on the basis of this new data. It would also be most interesting to learn how the authors think the PPP revision affects the more general appeal of the approach to exchange rates for both China and India, the data for which were also largely revised in the World Bank's price data.

Second, I am slightly surprised that the authors focus so much on studies of China's exchange rate that look only at that single country's rate, rather than at the full multilateral system of exchange rates. Exchange rates are relative values, and if one country is undervalued, then intuitively, other countries must be overvalued; that is, the system must balance overall. It thus seems entirely reasonable that any method should be able to assess not only China's exchange rate but all exchange rates on an even methodological playing field. Methods can reasonably be assessed in terms of how they give answers across all major trading countries. This is not as hard as it sounds, as including 30 or 40 countries covers most of world trade. I would further suggest that the authors put rather less weight on studies or methods that do not explicitly add up multilaterally. Also, it is generally less useful to focus on the bilateral dollar rate rather than on the real effective exchange rate. The authors do both, but I fear that an unsophisticated or selective reader may need more guidance— and the Peterson Institute is usually at the forefront of such guidance.

Third, I am disappointed that the authors did not include the International Monetary Fund's exchange rate methodology in their assessment. Its approach is in the public domain, and almost all of the data are also readily available (Lee, Milesi-Ferretti, and Ricci 2008). Particularly, as other official organizations develop exchange rate methodologies, it would be helpful and productive to have the authors' independent views on the comparative strengths and weaknesses of all available official methods vis-à-vis those covered in their paper. Even if official point estimates are

not published, which may often be the case, the methods are and should be subject to outside review and comment.

Overall, I fully agree with the authors' main idea that there is value in looking at varieties of both behavioral and current account–based approaches to the exchange rate. The behavior of net foreign assets can also be extremely informative regarding whether external payments are in something approaching equilibrium. A balanced approach, of the kind the authors prefer, is an excellent way to progress.

We have to become more discerning and honest about the methodological and data limitations of certain approaches and papers. The economics profession, leading journalists, and the broader economics-informed public very much look to the Peterson Institute to continue its leadership role on this issue.

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