CPB Memorandum

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Is the renminbi undervalued?[1]

The possible undervaluation of the renminbi is evaluated. A survey of the literature concludes toward a renminbi undervaluation of about 25% in real effective terms. This undervaluation is not expected to disappear any time soon.

1   Introduction

A debate has raged whether and to what extent the renminbi has been undervalued. To answer this question this Memorandum is first interested in the level of China's "equilibrium" (real effective) exchange rate. The relevant exchange rate is defined as the number of currency units per renminbi. This definition ensures that a rise (fall) in the exchange rate corresponds to an appreciation (depreciation) of the renminbi. Then, if the equilibrium exchange rate of the renminbi is higher (lower) than its actual exchange rate, the renminbi is said to be undervalued (overvalued).

Secondly, this Memorandum is interested in the methodology to determine the equilibrium exchange rate. Three approaches are generally applied in the literature to determine the equilibrium exchange rate: the macroeconomic balance approach, the purchasing power parity (PPP) approach and the extended PPP approach. The macroeconomic balance approach defines the equilibrium rate as the rate that leads to no change in international reserves or as the rate that corresponds to a current account balance equal to the structural domestic saving-investment balance. The PPP approach defines the equilibrium exchange rate as the rate that equalises the prices of an identical basket of goods and services at home and abroad. The PPP approach is based on the assumption that PPP holds in the long run. The extended PPP approach can be considered an intermediate approach between the PPP and the macroeconomic approach. In the long run, the exchange rate between two countries should move towards the rate that equalises the prices of (an) identical (basket of) goods and services in each country, but several factors may act to prevent the actual exchange rate from converging to the PPP-determined level in the short to medium term. The extended PPP approach calculates the equilibrium exchange rate after controlling for the influence of these factors.

All studies surveyed in Table 1.1 find the renminbi to be undervalued in real effective terms. An estimate of 25% undervaluation representing the median of the survey seems to be a fair summary of the current consensus.[2] The renminbi has to appreciate 25% to reach its equilibrium value. A real effective appreciation of 25% of the renminbi implies that the currencies of China's trading partners will depreciate by as much as 33.3% $[=((1/(1-0.25)-1)\times100\%]$.

The estimates in Table 1.1 vary widely and should be treated with great caution (Dunaway, Leigh, and Li, 2006) as China is undergoing spectacular structural change and as the quality of Chinese data is poor. In addition, various methodological problems arise when attempting to

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[2] Some studies do not subscribe to the consensus view. China still has many capital controls in place and its financial markets and financial institutions are underdeveloped. Consequently, the consensus 25% renminbi undervaluation in Table 1.1 should be seen under the ceteris paribus condition.

determine the equilibrium exchange rate in general, and these problems apply especially to developing countries such as China.

Table 1.1   Estimates of undervaluation of the renminbi

	Estimated undervaluation	Assessment year	
Coudert and Couharde (2005)	23%	2003	Macroeconomic balance approach
Goldstein (2004)	15-30%	2004	Macroeconomic balance approach
Goldstein and Lardy (2005)	15-25%	2005	Macroeconomic balance approach
Wang (2004)	small	2004	Macroeconomic balance approach
Frankel (2004)	36%	2000	Extended PPP approach
Funke and Rahn (2005)	11%	2000	Extended PPP approach
Coudert and Couharde (2005)	18-49%	2002	Extended PPP approach
Penn World Table (PWT 6.1)	77%	2000	against the dollar; PPP approach
OECD China study (2005), Guangdong-Hong Kong	46%	2000	against the dollar; PPP approach
World Bank WDI	78%	2003	against the dollar; PPP approach
IMF WEO	76%	2006	against the dollar; PPP approach
The Economist	58%	May 2006	against the dollar; PPP approach (Big Mac)

Source: Dunaway and Li (2005) and own additions.

The three approaches to measure the extent of undervaluation will be further investigated in Sections 2, 3, and 4, devoting special attention to the Chinese situation. Section 5 ends this Memorandum with a reflection on the short- to medium-term outlook for the Chinese currency.

2   The macroeconomic balance approach

The macroeconomic balance approach derives an estimate for the change in the real effective exchange rate needed to bring about equilibrium in the balance of payments.[3] Balance of payments equilibrium is usually defined in one of two ways: (i) as a situation where the "underlying" current account position is approximately equal and opposite in sign to "normal" net capital flows (so there is no change in international reserves),[4] or (ii) when the external current account balance is equal to the structural domestic saving-investment balance (or some structural norm, like stabilizing the ratio of net foreign assets to GDP at some appropriate level). In this respect it should be noted here that China's current and capital accounts are both

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[3] This Memorandum does not take a stand upon how large an appreciation of the renminbi is necessary for meaningful global rebalancing. The US current account deficit must narrow eventually and this will most certainly involve a significant depreciation of the dollar (see e.g. Obstfeld and Rogoff 2000, 2004, Blanchard, Giavazzi and Sa, 2005).

[4] Remember that payments for imports (exports) lead to a decrease (an increase) in foreign exchange held by the private sector, to a decreases (an increase) in the money supply and to a decrease (an increase) in offcial reserves, and if the exchange rate is flexible to a deprecation (an appreciation) of the renminbi.

in surplus.[5] The persistent "twin surpluses" have resulted in the continuous increase in China's foreign exchange reserves.

The macroeconomic balance approach involves three steps. First, a country's underlying current account position under the prevailing exchange rate is determined. This usually involves trying to remove the effects of differences in relative cyclical positions between countries and the delayed effects of past changes in the real exchange rate. In the second step, a norm is established, which is an indicator of equilibrium in the balance of payments. In the third step, the gap between the estimated underlying current account balance and its norm is calculated. Then, based on a trade model, the change needed in the real exchange rate (defined as the relative price term in the trade model) to close this gap is computed, with key parameters being the estimated price elasticity for the country's exports and imports. The computed change in the real exchange rate based on a trade model is treated as an estimate of the extent to which the current real exchange rate may be overvalued or undervalued.

The Chinese trade price elasticities are low. Estimation results by Marquez and Schindler (2006) suggest that a ten percent real appreciation of the renminbi lowers the share of aggregate Chinese exports by a half a percentage point. The same appreciation lowers the share of aggregate Chinese imports by about a tenth of a percentage point. In this context, the development during the 1997-98 Asian crisis is interesting as it provides an almost perfect real world test of what could happen should a renminbi appreciation occur. During this crisis the renminbi's real effective exchange rate appreciated by about 22% although the rate vis-à-vis the US dollar remained unchanged. As a result, China's gain in export market share came to a stand still. However, this was only for about two years. Thereafter, low Chinese inflation[6] reduced the real effective exchange rate of the renminbi and the upward trend in China's export market share was restored.

The macroeconomic balance approach concludes that the recent increase of China's current account surplus is in part caused by the undervaluation of the renminbi. Structural adjustments − including appreciation of the renminbi in real effective terms − are necessary to deal with the large current and capital account surplus.

The macroeconomic balance approach is a more complicated procedure than the (extended) PPP approach (see Sections 3 and 4), requiring a considerable amount of information to apply it. The results from this approach are heavily dependent several key elements in estimating the

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[5] The Chinese current account and capital account surplus in 2005 reached $160.8 billion and $63.0 billion, respectively (State Administration of Foreign Exchange, http://www.safe.gov.cn/).

[6] Rapid adjustment in domestic prices to lower import prices facilitates the adjustment of export prices, leaving the Chinese economy relatively flexible in the face of exchange rate shocks.

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needed change in the real exchange rate and the stability of estimated structural relationships relating savings, investment, and the current account balance. If the structure of the economy is changing over time, as is particularly the case for China, the stability of all of the relationships used in this approach to estimate the required change in the real exchange rate becomes questionable. The approach's chief advantage is that it can provide a forward-looking assessment of the equilibrium real exchange rate.

Financial markets' assessment of the equilibrium renminbi exchange rate

Financial markets daily apply the macroeconomic balance approach as follows. Assume that forecasts about the future bilateral US-China trade deficits[a] are already in the market. Assume that the market incorporates a forecast for future deficits half way between two deficit scenarios: I: high deficit and II: low deficit. Then interest rates and exchange rates should already have adjusted to the levels that the market thinks will finance the future prospective deficits. If the deficit turns out better[b] than currently expected in financial markets[c] (i.e. scenario II is valid), then one would expect US interest rates to fall and the US exchange rate to appreciate from present levels. In fact, change in interest and exchanges rates will occur intra-day.[d]

[a] Remember that international macroeconomists will care not so much about the US bilateral trade balance with China but about the overall US trade balance. China is only part of a much bigger problem in terms of the US trade imbalance.
[b] For example, obtained from the Bureau of Economic Analysis monthly news release, http://www.bea.gov/bea/di/home/trade.htm
[c] For example, obtained from the Bloomberg survey of economists, http://www.bloomberg.com
[d] A caveat is in order, here. The Chinese authorities heavily influence the renminbi-dollar exchange rate as well as the Chinese money and capital market interest rates.

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3 The purchasing power parity approach

It is useful to start the discussion of the PPP approach with the Law of One Price (LOP). The LOP is the foundation for the PPP theory. According to the LOP identical goods that can be internationally traded should (under certain conditions) sell for the same price in two different countries at the same time. Suppose that the exact same product, say a Big Mac hamburger, is freely traded in two different countries, say China and the US. Suppose, furthermore, that there are no transportation costs, no tariffs or other trade restrictions (e.g. due to differences in laws, regulations, and standards (health, safety, consumer protection)) that hamper arbitrage between these two countries, and no stickiness in prices because firms do no like changing prices all the time. Under those conditions, the LOP states that the price of the Big Mac in China should be the same as the price of the Big Mac in the US measured in a common currency. The LOP for each individual good i implies:

$$P_{US,i,t}, = S_t \ P_{China,i,t} \qquad i = 1,...,N \tag{1}$$

where $P_{China,i,t}$ is the price level of good i at time t in renminbi in China, $P_{US,i,t}$ is the price level of good i in dollars in the US at the same time, and S_t is the nominal exchange rate of the renminbi. So S_t is the price in dollars for purchasing one renminbi. Equation (1) can also be written as $S_t = P_{US,i,t} / P_{China,i,t}$ to give the LOP/PPP equilibrium exchange rate based on Big Mac prices. When the price of the good in the US begins to rise above the price of the same good in China (expressed in a common currency, so either expressed in renminbi or expressed in dollars), it will become profitable to buy the good in the low-price country (say China) and sell it in the high-price country (the US). Arbitrage will tend to drive up the price in China and drive down the price in the US. The process should continue until the prices expressed in a common currency are equalised in the two countries.

In 1986 The Economist magazine began publishing a survey of prices of Big Macs in a number of countries as a guide to whether a currency is under- or overvalued. The survey started to cover China in 1992 (with 1996 as an exception). The Big Mac survey has shown consistently that the renminbi has been undervalued against the dollar and the euro (see Tables 3.1 and 3.2). Policymakers do use the Big Mac survey to support their claims that the Chinese currency is undervalued. On 25 May 2006, for example, the Big Mac PPP exchange rate between the renminbi and the dollar was 0.2950. The actual exchange rate was 0.1245. So, comparing the PPP with the actual exchange rate implied that the Chinese currency was undervalued by 58% against the dollar.[7]

Table 3.1   Valuation of the renminbi against the dollar based on Big Mac prices

	Prices in renminbi	Prices in dollars	Actual renminbi exchange rate	Implied PPP of the renminbi	Renminbi under (-) / over(+) valuation (%)
14/01/2004	10.18	2.80	0.1208	0.2747	− 56
26/05/2004	10.43	2.90	0.1208	0.2778	− 57
13/12/2004	10.43	2.90	0.1208	0.2786	− 57
08/06/2005	10.51	3.06	0.1208	0.2907	− 58
09/01/2006	10.48	3.15	0.1241	0.3003	− 59
25/05/2006	10.50	3.10	0.1245	0.2950	− 58

Source: The Economist, various issues, own calculations.

How to read this table:
For example on 25 May 2006, if a Big Mac costs renminbi 10.50 in China and it costs 3.10 dollar in the US, then the PPP exchange rate would be 3.10/10.5 = 0.2952 dollar per renminbi. Since the actual exchange rate is lower, namely 0.1245 dollar per renminbi, the renminbi is said to be undervalued. Consequently, the value of the renminbi is expected to go up (appreciate) until it reaches the PPP exchange rate. The under(−)/over(+)valuation of the renminbi is calculated as follows:
[(Actual exchange rate − PPP exchange rate) / PPP exchange rate] × 100 = ((0.1245−0.2950)/0.2950) × 100% = −58%

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[7] An appreciation of 58% of the renminbi implies that the dollar would depreciate by 129%.

Table 3.2   Valuation of the renminbi against the euro based on Big Mac prices

	Prices in renminbi	Prices in euros	Actual renminbi exchange rate	Implied PPP of the renminbi	Renminbi under (-) / over(+) valuation (%)
14/01/2004	10.18	2.74	0.0955	0.2695	− 65
26/05/2004	10.43	2.67	0.0998	0.2558	− 61
13/12/2004	10.43	2.83	0.0907	0.2710	− 67
08/06/2005	10.51	2.96	0.0987	0.2817	− 65
09/01/2006	10.48	2.91	0.1027	0.2778	− 63
25/05/2006	10.50	3.10	0.0973	0.2950	− 67

Source: The Economist, various issues, own calculations.

The term PPP in the proper sense of the word connotes to a basket of goods rather than a single good. Unfortunately, the actual calculation of PPP based on a basket of price levels which is the preferred method to determine equilibrium exchange rates − known as *absolute* PPP applied to price levels − is rather problematic. The biggest problem is a lack of price level data.[8] Only if the actual price data of the same goods traded among different countries are available can the true PPP exchange rate level be calculated. In fact, however, the sole clear-cut example where one can easily apply this calculation seems to be The Economist's Big Mac survey.

Absolute PPP can also be applied to price indices. Calculation of *absolute PPP* based on price indices is much easier as it requires no actual price research. All countries publish several types of price indices, such as the consumer price index (CPI), the producer price index (PPI), the GDP deflator, the unit labour costs price index, etc.. All of these indices are constructed in different ways, and emphasise different aspects of the economy. The exposition below focuses on the CPI. The CPI is usually constructed as a weighted average of the prices of individual (groups of) internationally traded as well as internationally non-traded products, with the weights representing the share of income spent by households on a particular product in some reference year. Suppose the US CPI is denoted by $P_{US,t}$ and the Chinese CPI is denoted by $P_{China,t}$ and is constructed in the same way (this need not be the case, which of course is a potential cause of PPP deviation). The *absolute* PPP exchange rate equates the CPI in the two countries if expressed in a common currency, so that the purchasing power of one unit of a currency would be the same in the two countries. The formula for absolute PPP is:

$$P_{US,t} = S_t \, P_{China,t} \tag{2}$$

[8] The only source which provides useful price level data is the International Comparison Program (ICP) with a Global Office housed by the World Bank. It produces internationally comparable price levels, economic aggregates in real terms, and PPP estimates that inform users about the relative purchasing power of currencies. Unfortunately, no suitable price data are available for China. See http://www.worldbank.org/data/icp/index.html for more information on the ICP.

Alternatively, equation (2) can again be written with the absolute PPP exchange rate in front:

$$s_t = P_{US,t} / P_{China,t} \cdot$$

For developing countries with relatively low income levels, it is natural for the currency to be somewhat undervalued. One reason for the currency levels in developing countries to be undervalued is that since the domestic price levels in these countries start and stay at relatively lower levels, the PPP (equilibrium) exchange rates (defined as foreign prices divided by domestic prices) start and stay at relatively higher levels (so the degree of undervaluation is relatively large).The extended PPP approach will control for the predicted influence of differences in income levels, etc. (see Section 4 on the extended PPP approach). That prices are relatively low in China is not a surprise. Prices of many manufactured goods may be equalised by international trade, the price of labour which is important for the price of non-traded goods is not equalised.[9]

Real bilateral exchange rates

Another way of stating the proposition that absolute PPP holds is to say that the real exchange rate is constant in the long run. Previously in equation (2), I derived the nominal exchange rate between two countries consistent with absolute PPP. On that basis, I can now define the level of the real (bilateral) exchange rate, say q, as the difference between the nominal exchange rate and the price indices of the two countries.

$$q_t = s_t \times \left(P_{China,t} / P_{US,t} \right) \text{ or in logarithms } q_t = s_t - (p_{US,t} - p_{China,t}) \tag{3}$$

This bilateral real exchange rate then provides a measure of the deviation from absolute PPP based on price indices between the two countries. The exchange rates are again expressed in such a way that higher values constitute a stronger renminbi. The development of the bilateral real exchange rate measures the evolution of China's competitiveness relative to the US. More specifically, if the real exchange rate of the renminbi in equation (3) increases (decreases), this implies that the higher (lower) price of the renminbi in terms of dollars is only partially offset by differences in price developments between the US and China, so that China has become less (more) competitive compared to the US.

A simple, but quite convincing, demonstration of this relationship based on equation (3) is shown in Figures 3.1 and 3.2. The bilateral real exchange rates depict the renminbi exchange rate deflated by the CPIs of the US (Figure 3.1) or the euro area (Figure 3.2) and China. The exchange rates in Figures 3.1 and 3.2 have been deflated by the CPIs shown in Figure 3.3. Of

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[9] The Balassa (1964)-Samuelson (1964) effect results since non-traded goods and services enter the calculation of PPP (see for more the discussion *Non-traded goods and services* in Section 4).

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course, for absolute PPP based on price indices the selection of the base year becomes all important.[10] June 1995 is chosen as the base year because China pegged its currency to the dollar in the beginning of July 1995.

The bilateral real exchange rates of the renminbi have undergone some large swings. Between June 1995 and January 1998 the renminbi appreciated more than 8% vis-à-vis the dollar because China's inflation rate generally exceeded that of the US. Between January 1998 and August 2006, however, the renminbi depreciated about 21% against the dollar on a real basis because China's inflation rate was generally lower than that of the US. Furthermore, the renminbi depreciated almost 16% in real terms against the dollar since the beginning of the dollar peg in July 1995. The figures also show that on a nominal basis, the renminbi appreciated only 4% against the dollar since the beginning of the dollar peg.
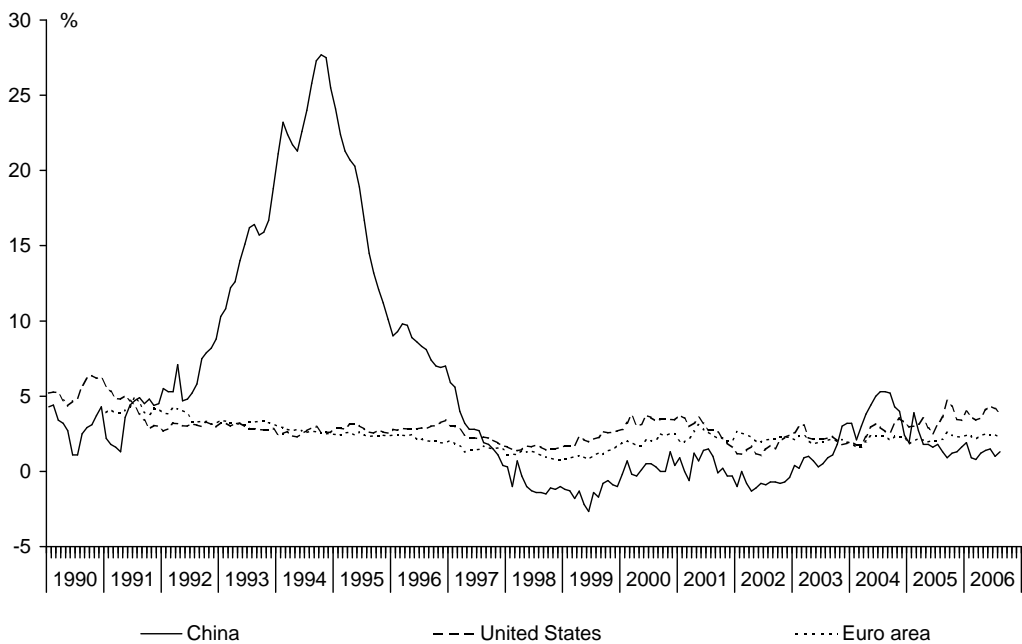
Figure 3.1   Dollar per renminbi

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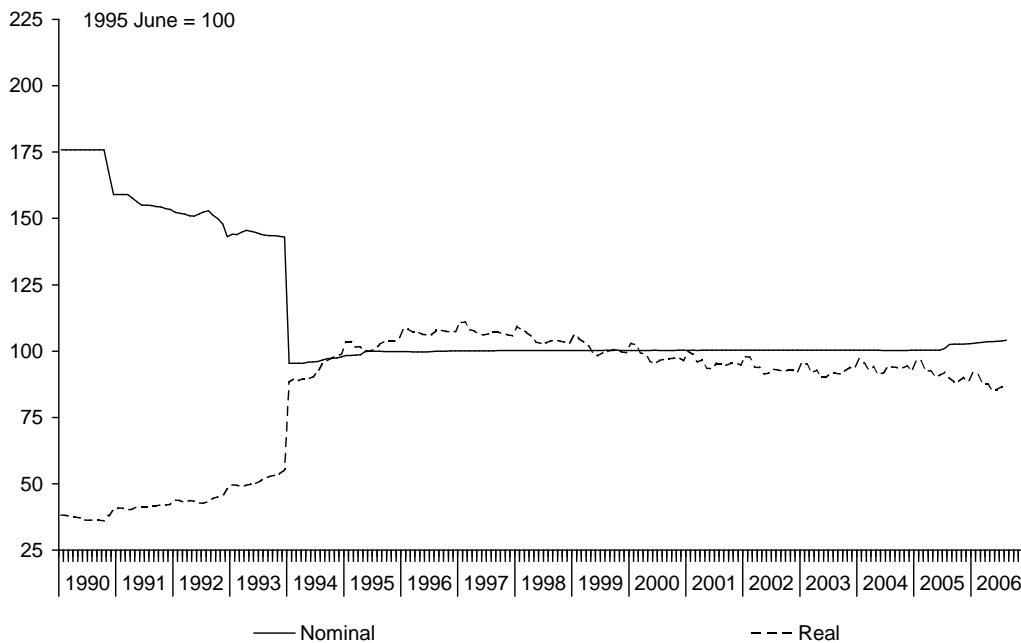
[10] The comparison against June 1995 depends on selecting a base year that is deemed to represent an equilibrium.

Figure 3.2   Euro per renminbi

1995 June = 100

Legend: —— Nominal   - - - Real
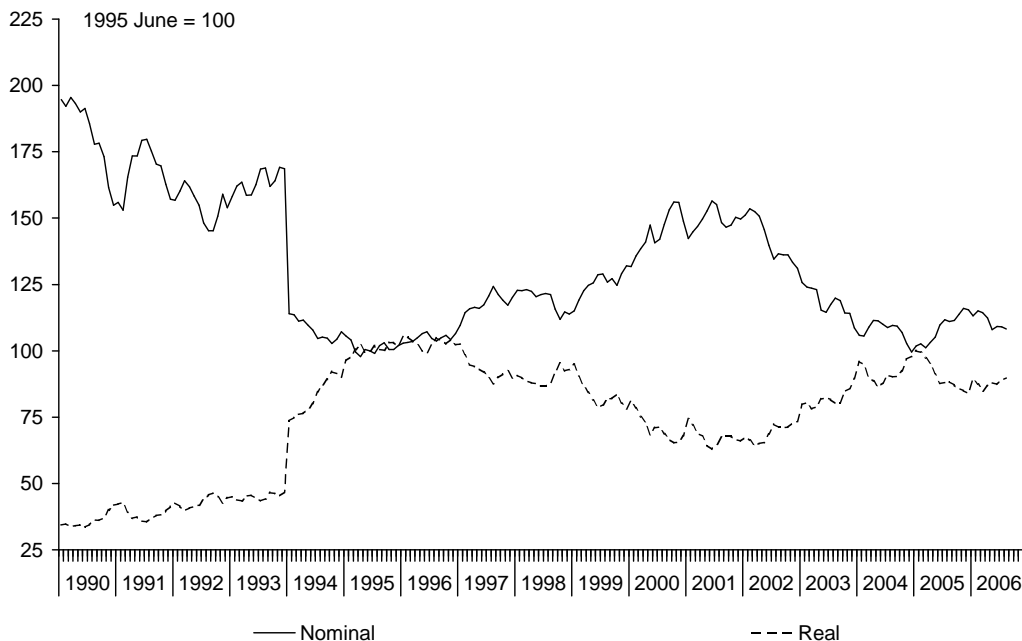
Figure 3.3   Consumer price index (12-month percentage change)

Legend: —— China   - - - United States   ······ Euro area

Real effective exchange rates

In practice, countries are more interested in the general development of their competitive position, not just relative to one country in particular. More than half of the Chinese exports go to markets other than the US. Thus a strategy of undervaluation by China to boost its exports should depend not just on the renminbi's exchange rate against the dollar but also on its

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effective (trade-weighted) rate against the currencies of all of its trading partners. The real effective exchange rate does just that, by calculating a weighted average of the bilateral real exchange rates. It plays an important role in policy analysis as an indicator of the competitiveness of domestic relative to foreign goods.

Figure 3.4 below shows the evolution of the real and nominal effective exchange rates for China over the period 1994 until now.[11]

Figure 3.4   Real and nominal effective exchange rates for China (broad, monthly averages; 2000=100)
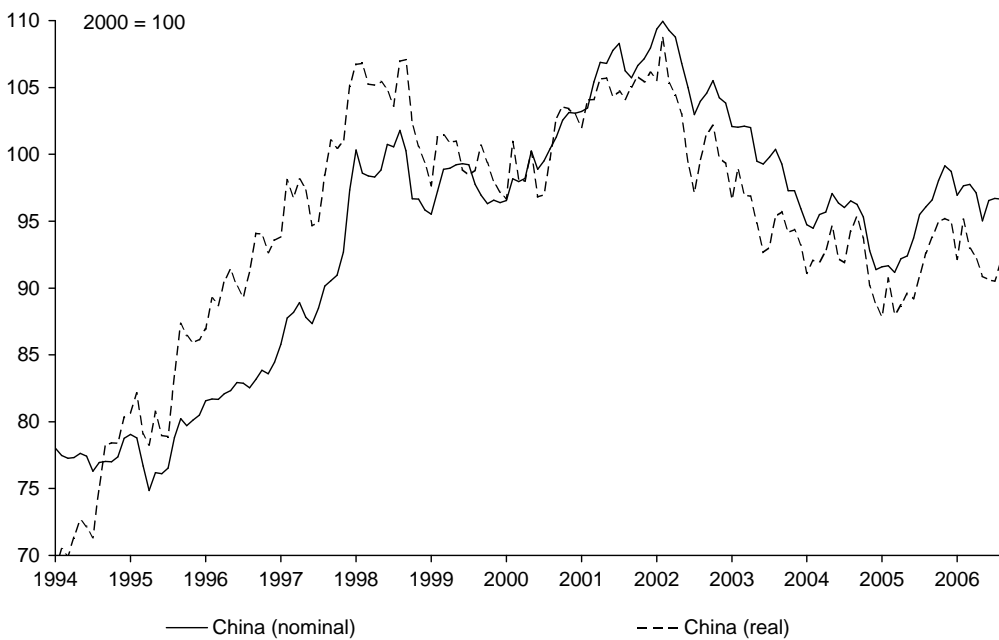
As the figure makes clear, there is not a big difference in the development of the real versus the nominal effective exchange rate for China. There is, however, an overall upward movement in the real effective exchange rate of the renminbi discernable over the period January 1994-September 2006. The Chinese effective exchange rate had been appreciating from 1994 to 1997 because of Chinese inflation which peaked in 1994. After 1994, the peg to the dollar has been a nominal anchor, leading to a fall in Chinese inflation which stabilised in turn the effective exchange rate of the renminbi. Furthermore, there is a large upward movement in the real effective exchange rate owing to the Asian crisis, and a large downward movement after that.

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[11] The Bank for International Settlements (BIS) has recently changed its effective exchange rate indices (Klau and Fung, 2006). Furthermore, the data are for the first time available on its website on a regular basis at www.bis.org/statistics/eer.htm. The new BIS effective exchange rates now cover 52 economies using time-varying trade weights. The BIS has also made statistical adjustments for China's trade that take account of Hong Kong SAR's significant role as an entrepôt for the mainland, as well as the partial reporting of trade between China and Taiwan due to the transhipment via Hong Kong SAR.

During the 1997-98 Asian crisis, the renminbi's real effective exchange rate appreciated by about 22% although its bilateral rate vis-à-vis the US dollar remained unchanged.[12] This effective appreciation was caused by appreciation vis-à-vis the currencies of the other dynamic Asian countries (these countries devalued their nominal exchange rates against the dollar) while inflation was clearly less than in those countries. The real effective exchange rate of the renminbi appreciated until 2001 and depreciated from 2001 to 2004, largely reproducing the fluctuations of the US dollar. Since the beginning of 2005, there is a small upward movement discernable in the effective exchanger rates of the renminbi. During the first half of 2006, however, the effective exchange rates of the renminbi were slightly depreciating again. In the beginning of the second half of 2006 the effective exchange rates of the renminbi have slightly appreciated.

4   The extended purchasing power parity approach

The extended PPP approach can be considered an intermediate approach between the PPP and the macroeconomic approach. In the PPP approach comparing actual exchange rates with PPP exchange rates indicated whether a currency is under- or overvalued. In the long run, the exchange rate between two countries should move towards the rate that equalises the prices of (an) identical (basket of) goods and services in each country. While PPP holds in the long run, several factors interact in the short to medium term to prevent the actual exchange rate from converging to its PPP-determined level. The extended PPP approach controls for the influence of these factors. The extended PPP approach calculates the equilibrium real effective exchange rate, taking into account the predicted influence of these factors. A single-country extended PPP equation is usually specified as follows (Dunaway, Leigh and Li, 2006):

$$\log(REER_t) = \alpha_0 + \alpha_1 \times \log(\mathrm{Re}\,lprod_t) + \alpha_2 \times NFAratio_t + \alpha_3 \times Other_t + \varepsilon_t \qquad (4)$$

where $REER$ is the measure for the real effective exchange rate for the home country; $\mathrm{Re}\,lprod$ is the productivity of the home country relative to the rest of the world; $NFAratio$ is the ratio of the home country net foreign assets (NFA) to some appropriate scalar; and $Other$ represent a collection of different variables that have been used in previous studies. Generally, in studies for developing countries including China, $REER$ is based on relative CPIs adjusted for exchange rates (see Section 3), because CPIs are most readily available price indices. $\mathrm{Re}\,lprod$ is often proxied by the ratio of the CPI to the PPI for the home country relative to the CPI/PPI for the country's major trading partners. The presumption is that this ratio proxies changes in the relative price of tradables to non-tradables, as the PPI consists of mostly tradables while the CPI

[12] The renminbi appreciated much more in effective terms than in nominal terms owing to the heavier weights on many depreciating Asian currencies during the Asian crisis.

consists mostly of non-tradables, and that there is a relatively close link between changes in this ratio and changes in relative productivity. However, there are many reasons to believe that there is not such a close link in the case of China (see the heading *Non-traded goods and services* below), as well as in many other countries. Alternatively, Re_{lprod} can be measured directly be the ratio of GDP per worker in the home country relative to that of its major trading partners. The $_{NFAratio}$ is meant to capture the influence of capital flows on the equilibrium exchange rate (see the heading *Net foreign asset positions* below). Empirically, it is often measured as the ratio of NFA to GDP or to exports. The $_{Other}$ variables include such things as the terms of trade (see the heading *Permanent shifts in the terms of trade* below) and a measure of external openness usually defined as the ratio of total trade to GDP.

To understand some of the deviations of long-run PPP in the context of China for which the researcher might want to control, it is most fruitful to examine again in more detail the many assumptions needed to invoke the LOP for individual goods on which PPP is based.

Transaction costs. An obvious reason for a failure of the LOP (and thus of PPP) is the existence of transaction costs, including shipping costs, insurance costs, tariffs and non-tariff barriers, etc. Any such transaction costs will impose a band width around the LOP/PPP exchanges rates within which arbitrage is not profitable. The band width will vary from one good to another.[13]

Differentiated goods. The LOP requires homogenous goods. In practice, very few goods are perfectly homogenous. Wines differ not only from one country to another, but even per region and vineyard, a Toyota differs from a Mercedes, there are many different varieties of tulips, etc.. As differentiated goods are lumped together when constructing price indices, it is no surprise that PPP does not hold.

Fixed investments and thresholds. Before one can take advantage of arbitrage opportunities, economic agents usually have to incur a fixed investment cost to do so, such as establishing reliable contacts, organize shipping and handling, have a distribution and service network, etc. In addition to the transaction costs imposing a band width, the sunk cost of investment associated with engaging in arbitrage ensures that traders wait until sufficiently large opportunities open up before entering the market.

Permanent shifts in the terms of trade. Permanent shifts in the terms of trade between traded goods take place, such as the upward shift that occurred due to the rise in the price of oil recently. Oil can have very different weights in the price indices of two countries, particularly if

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[13] One measure for the extent of these types of transaction costs is the deviation between cost, insurance, and freight (CIF) and free on board (FOB) quotations of trade.

PPIs rather than CPIs are considered. An oil producing country will experience a real appreciation of its currency when the relative price of oil goes up, whether in the form of a nominal appreciation of the currency or in the form of an increase in the PPI. Oil importing countries such as China face a real depreciation when the oil price rises.

Non-traded goods and services. When invoking the LOP to derive PPP, it was implicitly assumed that all goods entering the construction of the price index were tradable. In fact, a large share of our income, perhaps as much as 60 to 70 per cent is spent on non-tradable goods, that is on products or (more frequently) services that effectively cannot be traded between countries and for which arbitrage, which drives PPP, is not possible. The bias introduced in PPP based on the distinction between traded and non-traded goods is known as the Balassa (1964)-Samuelson (1964) effect. Growth of developing countries' income is generally associated with increased productivity in traded goods, which then fall in price relative to non-traded goods. In other words, the relative prices of non-traded goods in terms of traded goods rise. Since the price of traded goods are tied to world prices, a rise in the relative price of non-traded goods can only mean an increase in the price of non-traded goods relative to world prices. Consequently, domestic prices tend to rise faster than prices in the rest of the world, leading to an appreciation of the real exchange rate, the now classic Balassa-Samuelson effect. Developing countries with strong growth rates normally tend to have an upward trend in their relative prices and therefore in the real exchange rate of their currencies. Such countries often show trends of real appreciation in their currencies. Most PPP studies conclude that in the case of China, however, the real effective exchange rate has not appreciated in line with what might be predicted by the Balassa-Samuelson effect. This lack of strong Balassa-Samuelson effect is then used to conclude that China's currency is undervalued.

There are two basic reasons why there may not be a strong Balassa-Samuelson effect in China (OECD, 2005). First, a key assumption underlying the Balassa-Samuelson effect may not apply in the case of China. The Balassa-Samuelson effect is dependent on an economy being at full employment or very high level of employment. This condition is necessary in order to get rising wages in the traded goods and services sector as productivity in that sector increases and to get a significant spillover of this wage increase into the non-traded sector. With a large amount of unemployment and underemployed labour (estimated to be 150-200 million workers) China does not come close to fulfilling this condition. Because of a large body of available labour, increases in wages and consequently increases in consumer prices in China do not follow increases in productivity as closely as in other transition countries. Second, elements of China's CPI, such as utility prices, are still under government control, housing costs are imputed based on prices in rental markets that are not yet fully developed, and there is mismeasurement of price increase, especially in the CPI, because adequate adjustments for improvements in quality

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particularly of durable goods are not made. Liberalisation of price controls in China have affected the CPI and the PPI by different amounts and at different times, with the resulting changes in the ratio of the two price series potentially misinterpreted as changes in productivity.

Composition issues. In deriving the PPP exchange rate, I assumed that the price indices in the two countries are constructed in an identical way. In practice, this is not the case. Not only do the weights for different categories differ per country, but also the types of goods associated with each category. Obviously, these construction differences can cause deviations from PPP, even when the absolute LOP holds for every individual good. When dealing with many countries, as is the case when real effective exchange rates were calculated, these problems are exacerbated.

Net foreign asset positions. In addition to above causes of PPP deviations, a number of other variables can be included to help explain deviation from PPP, such as for example a country's net foreign asset position to proxy for cross-border capital flows. China's external financial position might play a prominent role in explaining deviations from PPP. China still has many capital controls in place (The Economist, 2005b) and its financial markets and financial institutions are underdeveloped (Setser, 2006).[14] The question is what would be the renminbi equilibrium value if the capital controls etc. were not in place. This might seem a hypothetical question, but greater renminbi flexibility in the future is likely to involve greater capital market openness. One might discover that the equilibrium renminbi rate is much weaker (the renminbi would be much less undervalued) than currently envisaged if massive capital outflows would occur from opening up the capital account. So the extent to which the lack of international integration of the Chinese financial system might be relevant to understand some of the undervaluation of the renminbi. The equilibrium exchange rate of the renminbi might not be as high as currently predicted, and the degree of undervaluation might be much less.

Concluding, the extended PPP approach requires less information than the macroeconomic balance approach, but more information than the PPP approach. However, similar to the PPP approach it is essentially backward looking in that it focuses on past behaviour of the exchange rate. The extended PPP approach is also subject to problems concerning the stability of underlying relationships as is the macroeconomic balance approach, as well as having its own problems associated with determining which causes of deviations from PPP should be controlled for and how they should be measured.

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[14] One key risk that has recently emerged concerns the overheating in the real estate markets across major cities in China.

5   The renminbi's outlook

The diverse estimates of renminbi undervaluation are not surprising given the difficulty in determining the equilibrium renminbi value. Moreover, the various approaches are difficult to apply to developing countries including China. Still, the renminbi at the moment is probably undervalued, according to the macroeconomic balance and the (extended) PPP approach. Of course, a real appreciation of say 25% of the renminbi toward a long-run equilibrium could be accomplished with no change in the nominal exchange rates of the renminbi. How? A Chinese inflation rate of 2.5% in excess of its trading partners would be enough. However, such an excess inflation would have to continue for at least the next decade, a situation which seems unlikely. The implication is that the resolution to the undervaluation is likely to involve nominal appreciation of the renminbi as well.

The above reasoning needs two qualifications. First, the People's Bank of China (PBoC) – the central bank of China – frequently intervenes in the foreign exchange market to buy dollars and sell renminbi to keep the renminbi from increasing in value with respect to mainly the US dollar (China would otherwise loose competitiveness). This is increasing the supply of renminbi in the foreign exchange market, driving down the renminbi's relative value, and increase the demand for US dollars, driving up the US dollar's relative value. The process also expands China's monetary base and risks generating inflation. In fact, this mechanism will prevent China from realizing in the (very) long-term a trade advantage from its stable exchange rate, because a rising inflation rate will eventually dull China's competitive edge.

Second, because China now has a more flexible exchange rate, there is also a domestic price (exchange rate) risk involved in holding foreign currency (predominantly dollars), making such holding capital uncertain. There is a genuine fear and concern with the Chinese authorities of a collapse of the dollar that would lead to a large capital loss on China's official investments in US Treasury bonds and other assets as cases do exist of foreign governments withdrawing balances of dollars on political, economic or other grounds. Any large attempt by the Chinese to sell US Treasury bonds (etc.) would probably turn prices and exchange rates against them.
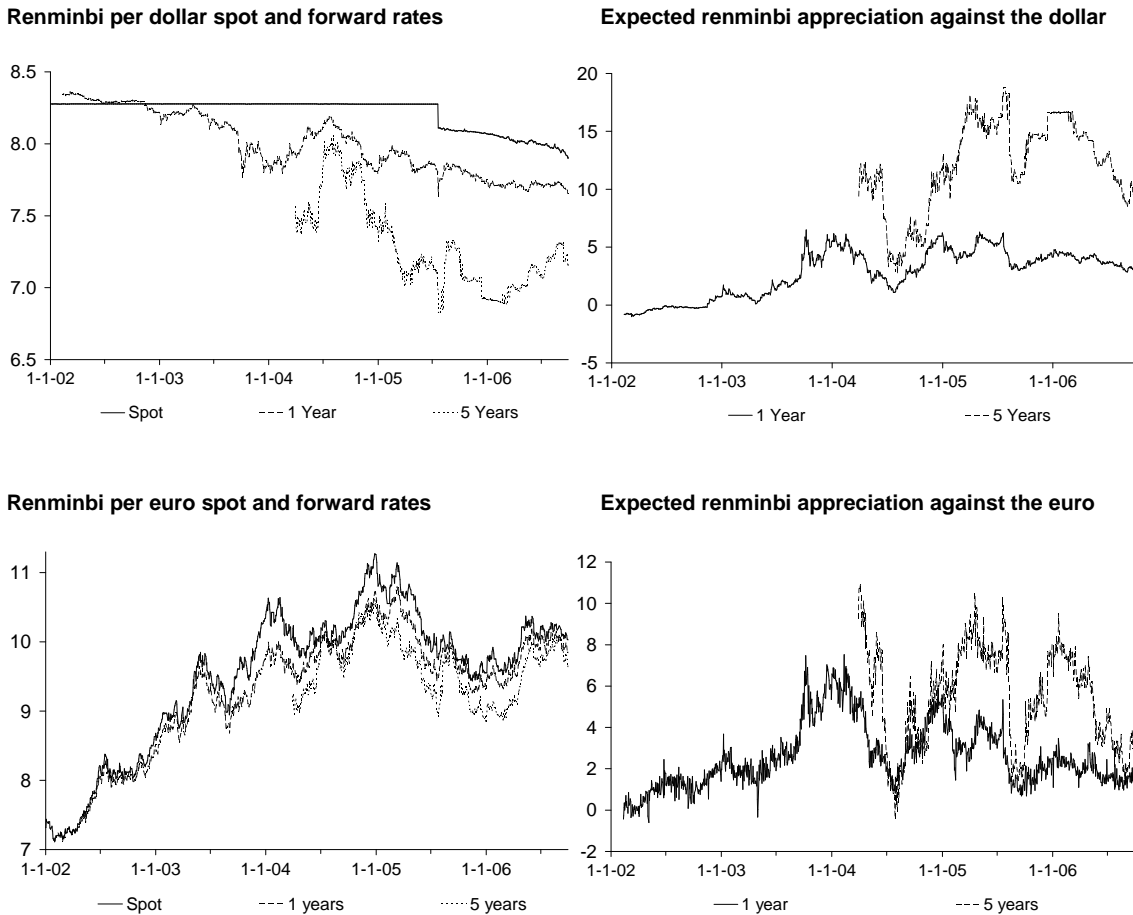
Is the renminbi likely to appreciate 25% anytime soon against major currencies?[15] Figure 5.1 draws the spot and the one and five year non-deliverable forward exchanges rates of the dollar and the euro in terms of renminbi and calculates market's expectations of renminbi appreciation implied by comparing the spot and forward exchange rates. Importantly, observe that for Figure 5.1 the exchange rates are expressed as normally quoted in the foreign exchange market

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[15] The renminbi is anchored to a currency basket (including dollar, euro, won and yen). The weights attached to each currency are not specified. Daily changes of the renminbi against the dollar are limited to ±0.3%.

(renminbi per dollar and renminbi per euro) which is in contrast to the definition of exchange rates used in Sections 1 to 4. The renminbi appreciated only about 2.6% since 21 July 2005 against the dollar up to 1 October 2006 following China's 2.1% renminbi revaluation on 21 July 2005, in spite of soaring Chinese trade surpluses, record US trade deficits and complaints from the US that the renminbi is undervalued.[16]

Figure 5.1   The short- to medium-term outlook for the renminbi against the dollar and the euro

Renminbi per dollar spot and forward rates

Expected renminbi appreciation against the dollar

Renminbi per euro spot and forward rates

Expected renminbi appreciation against the euro

The PBoC has recently permitted slightly greater daily volatility in the renminbi-dollar rate and allowed a series of record highs for its currency.[17] This has fuelled predictions it will widen the current 0.3 per cent daily trading band and allow a more rapid appreciation. More realistically, though, is that the Chinese like to move step-by-step and will probably move slowly for a while, halt, and see what has happened. If the situation seems to be propitious, and apart from other developments in financial markets[18], then the Chinese will move on.

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[16] For small values, the appreciation of the renminbi is approximately equal to the depreciation of the dollar. For larger values this is no longer the case.

[17] The reform of the foreign exchange market has gained momentum as well.

[18] Financial markets will determine the dynamics of global adjustment, in which the renminbi might play a crucial role (Obstfeld and Rogoff, 2000, 2004, Euroframe, 2005).

References

Balassa, B. The Purchasing Power Parity Doctrine: A Reappraisal, *Journal of Political Economy*, vol. 72, no. 6, pag. 584-596.

Blanchard, O. and F. Giavazzi, Rebalancing Growth in China: A Three-Handed Approach, *CEPR Discussion Paper*, no. 5403, January 2006, http://www.cepr.org/pubs/new-dps/dplist.asp?dpno=5403

Blanchard, O., F. Giavazzi and F. Sa, The US Current Account and Dollar, *NBER Discussion Paper Series,* no. 4888, February 2005, www.cepr.org/pubs/dps/DP4888.asp

Coudert, V. and C. Couharde, Real Equilibrium Exchange Rate in China, *CEPII Working Paper*, no. 1, January 2005, http://www.cepii.fr/anglaisgraph/workpap/pdf/2005/wp05-01.pdf

Dunaway, S. and X. Li, Estimating China's Equilibrium Real Exchange Rate, *IMF Working Paper*, no. 202, 2005, http://www.imf.org/external/pubs/ft/wp/2005/wp05202.pdf

Dunaway, S. L. Leigh, and X. Li, How Robust are Estimates of Equilibrium Real Exchange Rates: The Case of China, *IMF Working Paper*, no. 220. 2006, http://www.imf.org/external/pubs/cat/longres.cfm?sk=19471.0

Economist, The, *Yuan step a time*, January 20th, 2005a, http://www.economist.com/finance/displayStory.cfm?story_id=3576444

Economist, The, *Precisely wrong*, June 23rd, 2005b, http://www.economist.com/printedition/displayStory.cfm?Story_ID=4104209

Economist, The, *Big Mac index*, May 25th, 2006a http://www.economist.com/markets/bigmac/

Economist, The, *Gently towards the heavens*, March 30th, 2006b, http://www.electroniceconomist.com/background/displaystory.cfm?story_id=6746872

Euroframe, The Role China Can Play in Reducing Europe's Burden From a Global Balance of Payments Correction, Autumn Report, 2005, pag. 25-26, http://www.euroframe.org/fileadmin/user_upload/euroframe/efn/autumn2005/autumn_2005_report_efn_2.pdf

Goldstein, M., Adjusting China's exchange rate policies, *Institute for International Economics Working Paper*, no. 1, June 2004, http://www.iie.com/publications/wp/wp04-1.pdf#search=%22Adjusting%20China%E2%80%99s%20exchange%20rate%20policies%22

Goldstein, M. and N. Lardy, China's Exchange Rate Policy Dilemma, Institute of International Economics, 2005, http://www.aeaweb.org/annual_mtg_papers/2006/0107_1015_1301.pdf

Frankel, J., On the Renminbi: The Choice Between Adjustment Under a Fixed Exchange Rate and Adjustment Under a Flexible Rate*, NBER Working Paper*, no. 11274, 2004, http://www.nber.org/papers/w11274

Funke, M. and J. Rahn, Just How Undervalued is the Chinese Renminbi?, Blackwell Publishing LTD. *The World Economy*, vol. 28, no. 4, 2005, pag. 465-489, http://gulliver.econ.uni-hamburg.de/IWWT/homepage/qmwps/qm405.pdf

Klau, M. and S.S. Fung, The new BIS effective exchange rate indices, *BIS Quarterly Review*, March, 2006, pag. 51-65, http://www.bis.org/publ/qtrpdf/r_qt0603e.pdf

Marquez, J. and J.W. Schindler Exchange-Rate Effects on China's Trade: An Interim Report, Board of Governors of the Federal Reserve System, *International Finance Discussion Papers*, no. 861, May 2006, http://www.federalreserve.gov/pubs/ifdp/2006/861/ifdp861.pdf

McKinnon, R., China's Exchange Rate Trap: Japan Redux?, 2006, http://www.aeaweb.org/annual_mtg_papers/2006/0107_1015_1302.pdf

Obstfeld, M. and K. Rogoff, Perspectives on OECD economic integration: Implications for U.S. current account adjustment, in Federal Reserve Bank of Kansas City, *Global Economic Integration: Opportunities and Challenges*, March 2000, pag. 169-208, http://www.kc.frb.org/PUBLICAT/SYMPOS/2000/S00rogo.pdf

Obstfeld, M. and K. Rogoff, The unsustainable US current account position revisited, *NBER Working Paper*, no. 10869, October 2004, http://papers.nber.org/papers/w10869.pdf

OECD, Economic Review - China, Draft Economic Survey by the Secretariat, 3 June, Economics Department, Economic and Development Review Committee, Paris, 2005.

Samuelson, P.A., Theoretical Notes on Trade Problems, *Review of Economics and Statistics*, vol. 46, no. 2, 1964, pag. 145-154.

Setser, B., The Chinese conundrum: External financial strength, domestic financial weakness, *Paper produced for CESifo conference "Understanding the Chinese economy"*, April 15, 2006 http://www.rgemonitor.com/redir.php?sid=1&tgid=10000&cid=125863

Suyker, W. and H. de Groot (eds.), China and the Dutch economy: Stylised facts and prospects, *CPB Document*, no. 127, September 2006, http://www.cpb.nl/nl/pub/cpbreeksen/document/127/doc127.pdf

Takeuchi, F., How Undervalued is the Chinese Yuan? A New Examination of Purchasing Power Parity, *Japan Center for Economic Research Researcher Report*, no. 23, November 2003, http://www.jcer.or.jp/eng/pdf/kenrep030919e.pdf#search=%22how%20undervalued%20is%20the%20chinese%20yuan%20takeuchi%22

Wang, T., Exchange Rate Dynamics, In: E. Prasad (ed.), China's Growth and Integration into the World Economy: Prospects and Challenges, *IMF Occasional Paper*, no. 232, 2004, pag. 21-28.

Yang, J., The Big Mac Index and the Valuation of the Chinese Currency, School of Business and Public Management, The Center for the Study of Globalization, The George Washington University, November 2003, http://gstudynet.com/gwcsg/docs/BigMacIndex.pdf