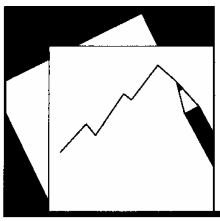
WP/05/202



IMF Working Paper

Estimating China's "Equilibrium" Real Exchange Rate

Steven Dunaway and Xiangming Li

INTERNATIONAL MONETARY FUND

 WP/05/202

IMF Working Paper

Asia and Pacific Department and Policy Development and Review Department

Estimating China's "Equilibrium" Real Exchange Rate

Prepared by Steven Dunaway and Xiangming Li

October 2005

Abstract

The number of studies attempting to estimate the "equilibrium" real value of China's currency has proliferated in recent years as the country's presence in world markets has grown. These studies have sought to establish whether or not a significant part of China's competitive prowess can be attributed to the foreign exchange value of the renminbi. Unfortunately, no consensus has emerged because the studies yield a very wide range of estimates. The paper looks at a sample of these studies, with estimates of undervaluation ranging from zero to nearly 50 percent. It attributes the wide variation in these estimates to the influence of such factors as the different methodologies used, explanatory variables included, subjective judgments of the various researchers in deriving their results, and instability in underlying economic relationships, especially in a rapidly developing economy like China.

JEL Classification Numbers: F31

Keywords: Exchange rates; foreign exchange

Author(s) E-Mail Address: sdunaway@imf.org; xli@imf.org

Contents Page

I. INTRODUCTION

As China's presence in world markets has risen dramatically in recent years, focus on its exchange rate arrangement as an important factor in explaining the country's competitiveness has increased. Consequently, a debate has raged over whether and to what extent China's exchange rate may be undervalued. A number of studies have attempted to answer these questions by estimating China's real "equilibrium" exchange rate. These studies have generally added to the heat of the debate, but they have not necessarily generated a lot of light on the issue, since they have yielded a very wide range of estimates. Table 1 summarizes the results from a representative sample of these studies, indicating that estimates of the renminbi's real equilibrium exchange rate range from little or no undervaluation to an undervaluation of nearly 50 percent. These results are not surprising, however, given the basic difficulty in empirically modeling exchange rates. The sharp variance in the estimates can in part be attributed to differences in methodology, the choice of variables used as proxies for the fundamental determinants of the equilibrium rate, and the period studied. Also, in some methodologies by necessity estimates are heavily influenced by the subjective judgment of the researcher. Moreover, the various estimation approaches are particularly difficult to implement in developing and transition economies, like China, where substantial structural changes make underlying economic relationships unstable.

Table 1. China: Estimates of Equilibrium Real Exchange Rate

Macroeconomic Balance Approach			PPP Approach		
	Estimated Undervaluation	Assessment Year		Estimated Undervaluation	Assessment Year
Goldstein (2004)	15-30 percent	2004	Lee, et al (2005)	Small undervaluation	2004
Wang (2004)	Small overvaluation	2003	Coudert and Couharde (2005)	18-49 percent	2002
Wang (2004)	Small undervaluation	2003	Wang (2004)	5 percent	2004
Coudert and Couharde (2005)	23 percent	2003	Frankel (2004)	36 percent	2000

The studies on China's real equilibrium exchange rate generally employ one of two broad approaches: a macroeconomic balance approach or an extended purchasing power parity (PPP) approach. The macroeconomic balance approach derives an estimate for the change in the real exchange rate needed to bring about equilibrium in the balance of payments. Balance of payments equilibrium is usually defined in one of two ways: (i) as a situation where "normal net capital inflows" equal the "underlying" current account balance (i.e., there is no change in international reserves) or (ii) when the external current account balance is equal to the "structural" domestic saving-investment balance (or some other structural norm, like stabilizing the ratio of net foreign assets to GDP at some "appropriate level"). This approach rests on the stability of structural relationships relating to savings, investment, and the external current account balance. It requires a relatively large amount of data and tends to

involve some subjective judgments to determine key elements in estimating the needed change in the real exchange rate. The extended PPP approach is in a sense a reduced form of the macroeconomic balance approach. It aims to estimate the equilibrium real exchange rate directly in a single equation. It is based on the assumption that, while purchasing power parity holds in the long run, several factors interact that prevent the actual exchange rate from converging to its PPP-determined level in the short to medium term. Taking into account the predicted influences of these factors—which often are derived using cross-country data—an equilibrium exchange rate is estimated. This approach is also subject to problems concerning the stability of underlying relationships, as well as having its own problems associated with determining which factors should be used in the estimation and how they should be measured.

II. The Macroeconomic Balance Approach

In the macroeconomic balance approach, the equilibrium exchange rate is determined indirectly as that needed to bring about "macroeconomic equilibrium." The approach generally 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. Common norms used are some measure for "normal" net capital inflows, an "appropriate" (or stable) ratio of net foreign assets to GDP, or an estimate of the medium-term structural domestic saving-investment balance. 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 (effectively defined as the relative price term in the trade model) to close this gap is computed, reflecting the estimated or assumed price elasticities for the country's exports and imports. The computed change in the real exchange rate is treated as an estimate of the extent to which the current real exchange rate may be overvalued (if the rate is expected to depreciate) or undervalued (if the rate is expected to appreciate).

The macroeconomic balance approach is a more complicated procedure, requiring a considerable amount of information to apply it. The results from this approach are heavily dependent on judgment and the stability of estimated relationships. The approach's chief advantage is that it can provide a forward-looking assessment of the equilibrium real exchange rate. The derivation of the underlying current account balance in the first step may entail considerable judgment and stable relationships between changes in domestic and foreign income and demand for imports and exports. The norm established in the second step of the approach can reflect the influences of structural changes in the economy over the medium term on equilibrium in the balance of payments. However, an important difficulty is to translate expected structural changes into their likely effects on a country's external position. Also, if the structure of the economy is changing over time, as is 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, particularly given that the "norm" itself should be a function of the real exchange rate as the economy becomes more open. Moreover, the final step in the approach involves using a partial equilibrium trade model to estimate the required change in the real exchange rate. All of the difference between the underlying current account balance and the current account norm is assumed to be eliminated through a

change in the real exchange rate. However, in reality output, interest rates, and price would change along with the exchange rate to bring a country's external position back into equilibrium. Thus, the macroeconomic balance approach may tend to overestimate the undervaluation or overvaluation of the real exchange rate. Lastly, there is a high degree of uncertainty surrounding the estimate of the change in the real exchange rate required to achieve balance of payments equilibrium derived from this approach given that this estimate is effectively a residual. Consequently, estimation errors in each of the three steps would compound.

Assessments of China's real exchange rate based on the macroeconomic balance approach have varied widely (Table 2). The variations are due to differences in specific assumptions made in these studies in each of the three steps to the approach. Underlying current account positions were approximated differently in all of the selected studies. Goldstein (2004) uses the projected current account position in 2004 adjusted for overheating of the economy and lagged trade effects of changes in the real effective exchange rate. Wang (2004) uses the average of 2000–2002. Coudert and Couharde (2005) adjust the underlying current account balance using estimates of potential GDP for China and its major trading partners and the lag structure from a quarterly trade model to estimate delayed passthrough of past exchange rate changes. The result is considerable differences in the estimates of the underlying current account balance. Differences also exist in the balance of payments norms used in these studies. Goldstein (2004) defines the norm in terms of the "normal" net inflow of capital, and calculates the exchange rate change required to equilibrate this capital flow with the current account balance, such that there would be no change in official international reserves. He derives the normal capital inflow as being equal to its average over the period 1999–2002. Wang (2004) and Coudert and Couharde (2005) both use estimates of the saving and investment balance for China derived from reduced-form models estimated by Chinn and Prasad (2003) and Jeong and Mazier (2002), respectively.[1] Wang (2004) also uses the 2001 ratio of net foreign assets to GDP as the norm and calculates the current account balance that would be consistent with stabilizing this ratio at that level over time. In the final step of the approach, Goldstein (2004) uses a trade model with price elasticities for China's export and imports that vary between 0.5 and 1 to test the sensitivity of his estimates of undervaluation.[2] Goldstein also explicitly allows for the fact that the import content of China's exports is relatively large (he estimates 35–40 percent). This may in part explain the larger estimates of undervaluation that he obtains. Coudert and Couharde (2005) do not explicitly allow for this processing trade effect in the trade model that they use.

[1] To use such norms to determine an equilibrium real exchange rate, it is implicitly assumed that the norm itself is not a function of the real exchange rate, which is a questionable assumption, particularly as the openness of the economy increases.

[2] The change in the exchange rate required to bring the underlying current account balance in line with its norm is inversely related to the size of the price elasticities in the trade model. Hence, the smaller the price elasticity, the larger the change in the exchange rate required.

Table 2. China: Estimates of Undervaluation Based on the Macroeconomic Balance Approach

	Underlying Current Account	Balance of Payments Norm	Estimated Undervaluation
Goldstein (2004)	2.5 percent of GDP	-1.5 percent of GDP (based on "normal" capital inflows)	15-30 percent
Wang (2004)	2.1 percent of GDP (average 2000-02)	3.1 percent of GDP (savings-investment balance from panel data estimates)	Small overvaluation
Wang (2004)	2.1 percent of GDP (average 2000-02)	0.98 percent of GDP (stabilizes NFA/GDP at 2001 level)	Small undervaluation
Coudert and Couharde (2005)	2.5 percent of GDP (model based)	-1.5 percent of GDP (savings-investment balance from panel data estimates)	23 percent

III. THE EXTENDED PURCHASING POWER PARITY APPROACH

The extended purchasing power parity method involves the direct estimation of an equation for the level of the real exchange rate. This approach requires less information than the macroeconomic balance approach. However, it is essentially backward looking in that it focuses on past behavior of the real exchange rate. It is based on the premise that over time a country's nominal exchange rate tends to converge to its level determined by PPP, but a variety of factors may keep the nominal exchange rate from converging to its PPP-determined level. These factors then can be used as the "fundamental" determinants in an equation that is estimated to explain past movements in the real exchange rate. In turn, the real exchange rate is generally treated as being in "equilibrium" when its actual value is equal to the value predicted by the estimated exchange rate equation (i.e., the exchange rate is in line with its fundamentals), and hence, the undervaluation or overvaluation of the real exchange rate is derived as the deviation of the actual real exchange rate from its estimated value.

The Balassa-Samuelson effect is the most common factor used to explain deviations from purchasing power parity. Differences between countries in relative productivity in their traded versus nontraded products (goods and services) sectors give rise to distortions in PPP. These differences in relative productivity may arise as countries develop, open up to international trade, and catch up with the technology used in more advanced countries. As a result, productivity in the traded sector tends to rise faster than in the nontraded sector. Accordingly, wages in the traded sector tend to rise in line with the increase in productivity, which in turn bids up wages in the nontraded sector. Nontraded wages rise faster than productivity in that sector, resulting in an increase in nontraded relative to traded product 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.

A number of other variables can also be included to help explain deviations from purchasing power parity. A country's net foreign asset position is often used as a proxy for capital flows. The expectation is that countries experiencing declines in their net foreign assets (or increases in their net foreign liabilities) should be facing depreciation pressures. Other variables added to extended PPP equations include changes in the terms of trade and the openness of the economy (see Lee, et al (2005) and Wang (2004)).

Most extended PPP studies find that, in the case of China, the real effective exchange rate has not appreciated in line with what might be predicted by the Balassa-Samuelson effect. This lack of a strong Balassa-Samuelson effect is used by Frankel (2004) and Coudert and Couharde (2005) to conclude that the Chinese currency may be undervalued (Table 3). Using the results from regressions done on a panel of data for a large number of countries, these two studies determine what the authors characterize as a "normal" coefficient for the Balassa-Samuelson term in an extended PPP equation. The gap between the actual real exchange rate for China and a value calculated assuming a normal Balassa-Samuelson effect is taken as representing a possible undervaluation of the Chinese real exchange rate. The larger estimate of possible undervaluation obtained by Frankel (2004) may reflect his use of a large group of countries, including both developed and developing countries. Coudert and Couharde (2005) use a smaller group of countries restricted to emerging market economies. Coudert and Couharde (2005) also find that estimates of possible undervaluation are higher when relative PPP per capita income is used as a proxy for relative productivity than when the relative ratio of consumer prices to producer prices is used as the proxy. Lee et al. (2005) use panel data for 39 developed and developing countries to derive an extended PPP equation and in effect a "normal" Balassa-Samuelson effect. However, Lee et al. (2005) add net foreign assets, the terms of trade, and a proxy for imperfect substitutability (the output of manufactured goods relative to partner countries) as additional variables explaining the real exchange rate. Differences in how the real exchange rate is defined as well may help to explain the wide range of the estimates of undervaluation in these studies. In contrast, Wang (2004) estimates an extended PPP equation for only China and finds a significant Balassa-Samuelson effect in an equation that includes as explanatory variables net foreign assets and a proxy for the openness of the economy (based on the expectation that a restrictive trade regime would tend to be linked to a more appreciated exchange rate).[3]

[3] Coudert and Couharde (2005) do not find a significant Balassa-Samuelson effect in an equation estimated only for China. Wang's finding of a significant effect may reflect the additional explanatory variables included in her equation and/or the differences in the data used and the time period over which the equations were estimated.

Table 3. China: Estimates of Undervaluation Based on the Extended PPP Approach

	Samples	Dependent Variable	Independent Variable			Undervaluation
			Relative Productivity	Net Foreign Assets	Others	
Frankel (2004)	118 countries in 2000 Penn World Trade	Price level relative to the U.S.	PPP per capita income relative to the U.S.	…	…	36 percent
Coudert and Couharde (2005)	145 countries, with population over 1 million, for 2003	Bilateral real exchange rate against the U.S. dollar	PPP per capita income relative to the U.S.			49 percent
Coudert and Couharde (2005)	21 emerging market countries between 1980 Q1 to 2002 Q4	Bilateral real exchange rate against the U.S. dollar	Ratio of CPI to PPI			18 percent
				…	…	
Lee et al. (2005)	39 developed and developing countries, 1980-2003	CPI-based real effective exchange rate	Relative GDP per worker relative to trading partners	Cumulative current accounts scaled by GDP or exports	Terms of trade, imperfect product substitutability	Small undervaluation
Wang (2004)	China, 1980-2003	CPI-based real effective exchange rate	Ratio of CPI to PPI	Cumulative current accounts scaled by GDP	Trade openness, dummy variable for 1980-86	5 percent

There are two basic reasons why there may not be a strong Balassa-Samuelson effect in China, implying that the extended PPP approach might overstate an undervaluation of the country's real exchange rate. 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 a very high level of employment. This condition is necessary in order to get rising wages in the traded products sector as productivity in that sector increases and to get a significant spillover of this wage increase into the nontraded sector. With a large amount of unemployed and underemployed labor (estimated to be somewhere on the order of 150–200 million workers), China does not come close to fulfilling this condition. Second, the Balassa-Samuelson effect may be misspecified in many of the estimated extended PPP equations estimated. Because of the lack of data, the Balassa-Samuelson relative productivity effect is often proxied by the ratio of China's consumer price index (CPI) to its producer price index (PPI) relative to the same ratio for China's trading partners. Use of this proxy presumes that there is a relatively close link between changes in productivity and changes in the CPI/ PPI ratio. However, such a link may be less apparent in China. 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 increases, especially in the CPI, because adequate adjustments for improvements in quality particularly of durable goods are not made. Consequently, the link between changes in wages and prices in China may be rather weak. In addition, liberalization of price controls in China may have affected the CPI and the PPI by different magnitudes and at different times, with the resulting changes in the CPI/PPI ratio misinterpreted as changes in relative productivity.

IV. Concluding Remarks

Given the methodological and empirical difficulties in trying to measure an "equilibrium" exchange rate, the wide range of estimates for undervaluation of China's currency, even within a given approach, is not surprising. The numerous studies done thus far have stoked further debate, rather than contributed to forming a consensus on the issue, and unfortunately, a more definitive answer is not likely to be forthcoming any time soon. Researchers have made their best efforts to overcome the obstacles that they face; however, the basic limitations in the approaches used to estimate an equilibrium exchange rate are formidable. Data problems—in the specification of both dependent and explanatory variables—remain substantial and will only be solved with time. It is also only in time that key underlying economic relationships determining a country's exchange rate may stabilize sufficiently that they might be estimated with a reasonable degree of confidence. But then again because of the complexity of these relationships, being able to accurately explain movements in exchange rates may remain an elusive objective. In the meantime, estimates of the level of a country's real exchange rate should continue to be treated with great caution.

References

Chinn, Menzie, and Eswar Prasad, 2003, "Medium-Term Determinants of Current Accounts in Industrial and Developing Countries: An Empirical Exploration," *Journal of International Economics*, Vol. 59, No. 1 (January), pp. 47-76.

Coudert, Virginie, and Cécile Couharde, 2005, "Real Equilibrium Exchange Rate in China," Working Paper No 2005 -01, CEPII.

Edwards, Sebastian. 1989, *Real Exchange Rates, Devaluation, and Adjustment* (Cambridge: The MIT Press).

Eichengreen, Barry, 2004, "Chinese Currency Controversies," Discussion Paper 4375 (London: Centre for Economic Policy Research).

Frankel, J., 2004, "On the Renminbi: The Choice Between Adjustment Under A Fixed Exchange Rate and Adjustment Under a Flexible Rate," NBER Working Paper 11274 (Cambridge, Massachusetts: National Bureau of Economic Research).

Goldstein, M., 2004, "Adjusting China's Exchange Rate Policies," Paper presented at the International Monetary Fund's Seminar on China's Foreign Exchange System, Dalian, China, May 26-27.

Jeong, S.E., and J. Mazier, 2003, "Exchange Rate Regimes and Equilibrium Exchange Rates in East Asia," Revue économique, vol. 54, no. 5 (September), pp. 1161-1182.

Lee, J., G. M. Milesi-Ferretti, L. Ricci, and S. Jayanthi, 2005, "Equilibrium Real Exchange Rates: Estimates for Industrial Countries and Emerging Markets" (unpublished; Washington: International Monetary Fund).

Meese, Richard, and Kenneth Rogoff, 1983, "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?" *Journal of International Economics*, Vol. 14 (February), pp. 3-24.

Rogoff, Kenneth, 1996, "The Purchasing Power Parity Puzzle," *Journal of Economic Literature*, Vol. 34, pp. 647-668.

Wang, Tao, 2004, "Exchange Rate Dynamics," *China's Growth and Integration into the World Economy: Prospects and Challenges, ed. by Eswar Prasad, IMF*. Occasional Paper 232 (Washington: International Monetary Fund).