Hong Kong Monetary Authority

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THE YEN EXCHANGE RATE AND NET FOREIGN ASSETS

Key points :

- *This note assesses the trend (equilibrium) value of the yen by considering a number of fundamental factors, in particular net foreign assets. Japan has accumulated substantial net foreign assets, amounting to 33% of GDP at end-2001. Standard open-economy models suggest that these assets may underpin the strength of the exchange rate.*

- *The empirical estimates support the theory. The trend value of the yen is estimated to have appreciated in the 1980s, and has remained broadly stable since the early 1990s. In the latter period, the positive effect of net foreign assets was offset by downward pressure arising from deterioration of the terms of trade and slower relative productivity growth. The derived equilibrium value of the yen is around 120 per US dollar at present.*

- *The analysis suggests that the proposal to devalue the yen as a way out of the liquidity trap may require a potentially large-scale intervention by the Japanese authorities in the foreign exchange market. Such an initiative in the face of little signs of an over-valuation would cause concerns from Japan's trade partners about a "beggar thy neighbour" policy.*

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I.   Introduction

Movements of the yen exchange rate often draw much attention from policymakers and analysts around the world, given Japan's importance in the global economy and financial markets. Fluctuations in the yen-dollar rate in the 1980s were an important factor contributing to trade frictions between Japan and the United States. The depreciation of the yen against the dollar, beginning in mid-1995, eroded the external competitiveness of a number of Asian economies that had pegged their currencies to the dollar, and was regarded as one of the triggers for the Asian financial crisis. More recently, the strength of the yen is considered a drag on Japan's economy, which has suffered from weak domestic demand and deflationary pressures. As the short-term nominal interest rate has reached the zero bound, some have proposed a sharp depreciation of the currency as a way out of the liquidity trap.[1]

Should the Japanese authorities embark on such a policy, the rest of Asia including particularly Hong Kong—whose currency is linked to the US dollar—will be affected. It is thus important to be informed about the debate on the yen exchange rate. This paper studies the trend of the yen exchange rate by examining some fundamental factors that underpin its long-run value. In particular, it considers the role of the net foreign asset position (NFA*)*. In the long term, a positive NFA position enables an economy to run trade deficits with an appreciated real exchange rate. Japan has run persistent current account surpluses, and accumulated net foreign assets amounting to US$1.4 trillion at the end of 2001, equivalent to 33% of GDP, or more than threefold total exports.

It should be stressed at the outset that exchange rates are highly volatile and unpredictable, and economists have had little success in forecasting exchange rate movements in the short term or even explaining them *ex post*.[2] This study is not intended to provide any projections for the near-term movement of the yen exchange rate. Over the medium to long term, however, it is generally agreed that real exchange rates tend to revert to their fundamental values. While it is difficult to know when adjustments will take place, it is important to anticipate the potential risks and costs that may be associated with an adjustment. This should also help assess the implications of any policy measures that may facilitate or hinder the adjustment.

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[1] The most prominent proposal is by Svensson (2001).
[2] See Meese and Rogoff (1983) for a pioneering work that highlights difficulties in forecasting exchange rate movements, and Gerlach (1987) for a review of the theoretical and empirical literature.

The rest of the paper is organised as follows. The next section considers the nexus between net foreign assets, the current account balance and the real exchange rate by briefly reviewing the theoretical and empirical literature. Section III provides an empirical estimate of the long-run trend value of the real effective exchange rate (REER) of the yen. To this end, it first outlines an empirical framework which follows recent developments in the literature, and particularly efforts at the IMF in exploring alternative methods for assessing the equilibrium value of a currency. This is followed by a summary of stylized facts and empirical estimates. Section IV concludes by offering some observations on macroeconomic and policy implications of the estimates. In particular, it considers the proposal of an intervention by the Japanese authorities to achieve a large depreciation of the yen in order to get the economy out of the deflation trap.

II. Net foreign assets and the real exchange rate: analytical issues

The relationship between net foreign assets and the real exchange rate has long been studied in the theoretical literature. In a simple Keynesian setting, countries with large external liabilities need to run trade surpluses in order to service them, and achieving trade surpluses requires a relatively depreciated currency. Later studies extend the analysis by introducing different sectors and using the intertemporal optimising framework.[3] In particular, it is recognized that while in the steady state a positive NFA position supports a more appreciated exchange rate, in transition, the exchange rate movements may be a means of reaching a desired level of net foreign assets.

These considerations can be illustrated using a simplified standard intertemporal open-economy model.[4] The current account is defined as the sum of net exports and interest income from a country's net foreign assets. Net exports is influenced by the real exchange rate (q_t), and a shift parameter (x_t) encompassing other factors that affect the relative supply and demand of domestic and foreign goods. Hence, the current account equation can be written as:

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[3] See, for example, Mussa (1984), Buiter (1989), Obstfeld and Rogoff (1995), Faruqee (1995), and Lane and Milesi-Ferretti (2000).
[4] For details, see Faruqee (1995).

(1) $\qquad CA_t = \dot{b}_t = -\gamma q_t + x_t + r_t b_t; \qquad \gamma > 0,$

where:

b =   net foreign assets;

q =   real exchange rate defined as the foreign price of a unit of domestic currency so that an increase represents appreciation;

r =   return on international investment.

In the equation, a dot variable denotes a time derivative. Therefore, $\dot{b}$ represents the change in the stock of net foreign assets held by the home country, which equals to its current account balance.

In the steady state, the economy reaches the desired or equilibrium position of net foreign assets ($\bar{b}_t$) so that $\dot{b}_t = 0$. Thus, the equilibrium exchange rate is derived as:

(2) $\qquad \bar{q}_t = \dfrac{1}{\gamma}\,(r_t \bar{b}_t + \bar{x}_t).$

Fundamentals that determine an economy's desired *NFA* position may include variables such as demographic factors, which affect net saving behaviour through life-cycle effects, or government debt, which influences net national borrowing in the absence of Ricardian equivalence.

Before the equilibrium is reached, the rate of *NFA* accumulation is affected by the gap between the desired and current levels of net foreign assets. That is:

(3) $\qquad \dot{b}_t = \phi(\bar{b}_t - b_t); \qquad \phi > 0,$

Combining (1), (2) and (3) gives:

(4) $\qquad q_t = \bar{q}_t - \alpha\,(\bar{b}_t - b_t) - \dfrac{1}{\gamma}\,(\bar{x}_t - x_t),$

where $\alpha = (r + \phi)/\gamma > 0$.

Equation (2) shows that in the steady state, higher net foreign assets are associated with a more appreciated currency, while Equation (4) demonstrates that the adjustment path of the exchange rate may be different from its long-run value. Thus, a shock that increases the desired (equilibrium) level of *NFA* will lead to an appreciation in the long run. During the adjustment process, however, the real exchange rate may depreciate in order to improve the trade balance and accumulate the required net foreign assets.

Only a small number of studies have explicitly incorporated net foreign assets when modelling exchange rate movement.[5] This in part reflects the limitation of data, as statistics on net foreign assets are available only for some developed economies and then only for recent decades. Most of these studies use panel data, and find that higher levels of net foreign assets are associated with currency appreciation.

III.   An estimate of the trend REER

1.   Empirical framework

The empirical framework follows recent efforts at the IMF in exploring the use of a relative purchasing power parity (*PPP*) concept for computing medium-term equilibrium exchange rates (Alberola *et al.*, 1999). The relative *PPP* paradigm is extended to take account of changing economic conditions. The path of the medium-term effective equilibrium exchange rate is assumed to depend upon trends in relative productivity growth (*PROD*), net foreign assets (*NFA*), and the terms of trade (*TT*). Specifically,

$$(5) \qquad REER_t = f\,(\overset{(+)}{PROD_t}, \overset{(+)}{TT_t}, \overset{(+)}{NFA_t})\,.$$

REER is a trade weighted, CPI-based real effective exchange rate.

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[5] These studies include Faruqee (1995), Gagnon (1996), Alberola *et al.* (1999), Lane (2000), and Lane and Milesi-Ferretti (2000).

In addition to net foreign assets, changes in relative productivity growth and the terms of trade may drive the *REER* away from the level implied by *PPP*.[6] The impact of relative productivity growth on the real exchange rate is known as the Balassa-Samuelson effect. It captures the notion that productivity growth tends to occur in the tradable sector, which draws resources from, and hence raises costs in, the nontradable sector. Consequently, relative prices of nontradables in countries with higher productivity growth will rise faster, causing real appreciation. In this study, relative productivity growth is proxied by the ratio of purchasing power adjusted GDP *per capita* of Japan to that of its trading partners.

The terms of trade influences the equilibrium real exchange rate *via* several channels. In the presence of a home bias in consumption, an increase in the relative price of home exports directly translates into a rise in the consumer price of the home economy relative to that of the foreign economy. There may also be an income effect by which rising domestic incomes bid up the relative price of nontradables.

The model is estimated following the Johansen (1995) approach, which identifies possible long-run relationships among the variables within a multivariate cointegration framework. Recent studies of exchange rate determination often employ a cointegration framework to distinguish variations of the real exchange rate due to changing trends in economic fundamentals and those due to short-term fluctuations in fundamentals and monetary factors. Examples include Behavioural Equilibrium Exchange Rate (BEER) and Permanent Equilibrium Exchange Rate (PEER) by Clark and MacDonald (1998, 2000), among a large number of time series and panel data applications.

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[6] The effects of productivity growth and the terms of trade on the equilibrium exchange rate have been examined extensively in the literature. See, for example, Chinn (1997).

2.   *Data and stylized facts*

All variables are in logarithms except for *NFA*, which is scaled by exports of goods and services. This reflects the consideration that the impact of the REER on the trade balance depends on the level of openness. More details on variable definitions and data sources are provided in Appendix 1.[7]

Chart 1 plots the explanatory variables together with the *REER*. It shows that the yen appreciated in effective terms in the past two decades, but with a number of swings. Relative per capita GDP shows an upward trend in the latter part of 1980s, reflecting the booming economy and the appreciation of the yen. It declined in the 1990s, particularly in the later years, owing to persistent economic weakness. The terms of trade improved sharply during 1985-86, in part reflecting the yen appreciation against the US dollar following the Plaza Agreement. It subsequently fluctuated considerably, but with a broadly downward trend. This may be associated with declining prices of manufactured goods in the world market during the period.

Net foreign assets have a clear upward trend, which was temporarily interrupted only in the late 1990s as Japanese banks scaled back overseas lending in response to the domestic banking crisis, and firms and investors withdrew funds from overseas in view of economic uncertainty following the Asian financial crisis. The continuous accumulation of net foreign assets has implications for the structure of the current account balance. Increasing net foreign assets brought about a rising net investment income, while Japan's current account surpluses remained relatively stable as a fraction of GDP (Chart 2). This is consistent with the notion that rising net interest income supports a fall in trade surpluses, underpinning the long-term strength of the yen.

These considerations suggest that while fundamental factors determine the equilibrium value of the REER in the long run, there exists considerable two-way causation in the short run. This highlights the importance of the multivariate cointegration framework employed in this paper, as opposed to single-equation estimation.
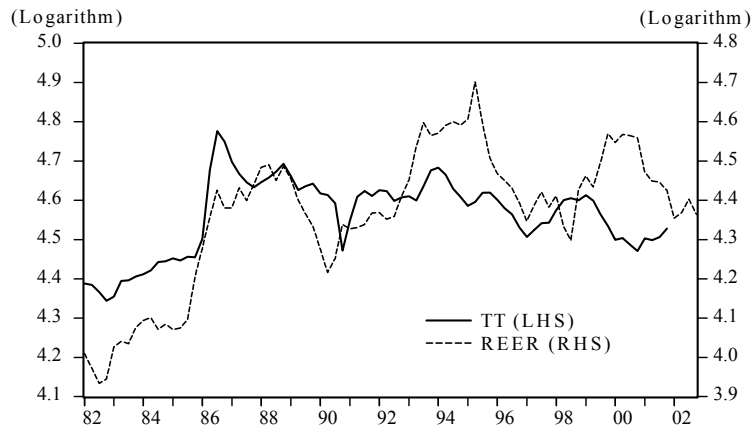
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[7] The time series properties of the variables are examined using the Augmented Dickey-Fuller test. The test statistics are also presented in Appendix 1, which show that all the variables are integrated of order one.
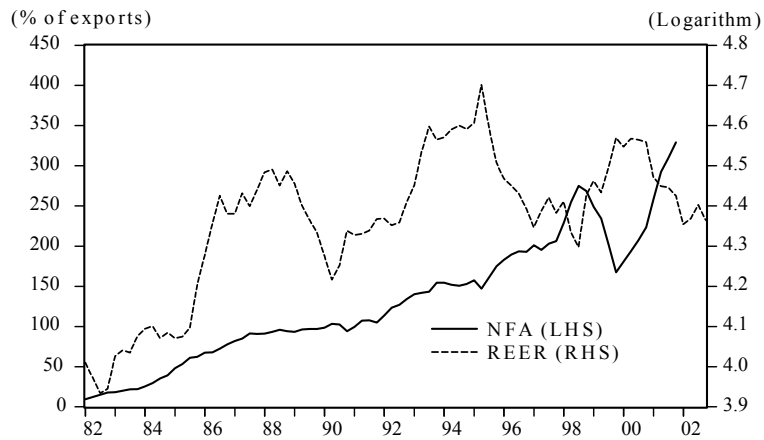
Chart 1. REER and Fundamentals

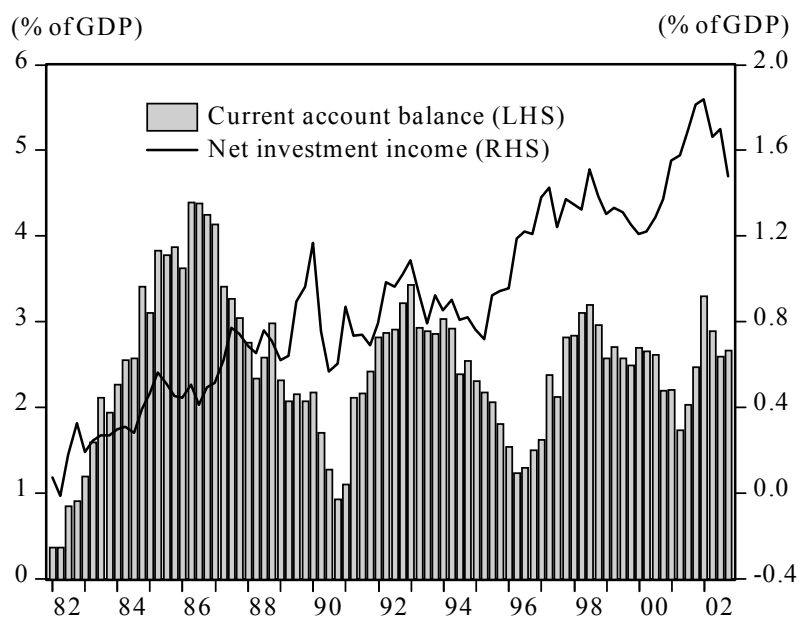### (a) *REER* and *PROD*
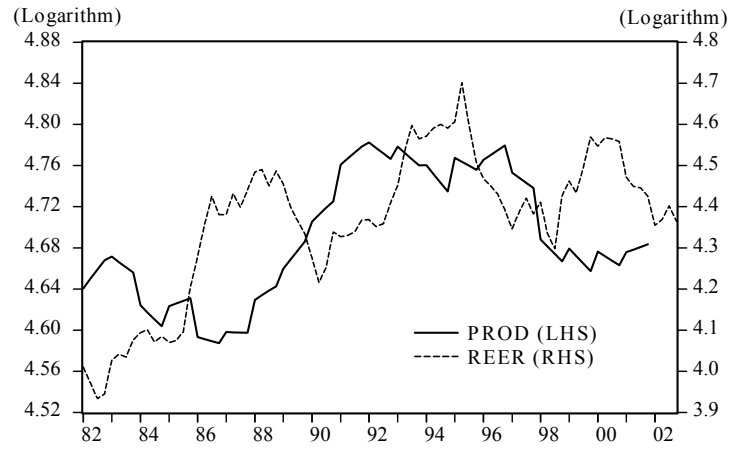
(b) *REER* and *TT*

(c) *REER* and *NFA*

Chart 2. Current Account Balance and Net Investment Income

3.   *Estimates of the long-run trend value of the yen*

In order to apply the Johansen framework to identify long-run relationships, a VAR containing *REER*, *PROD*, *TT* and *NFA* is estimated. Based on the general-to-specific approach, the lag length of 5 is chosen. Standard diagnostic tests indicate that the VAR is generally well-specified (Panel (A) of Appendix 2). The trace statistics suggest that there is one cointegrating vector among the four variables (Panel (B) of Appendix 2).

Consequently, the model is estimated as a VECM with one cointegrating vector. In the resulting long-run relationship, *TT* and *NFA* are significant, and correctly signed. *PROD* also has the expected sign, but its t-statistics is only close to conventional levels. This reflects limited variations in relative per capita GDP, as compared with the REER and the other two variables.[8] As the coefficient on *TT* appears to be close to one, the model is re-estimated with a restriction that the coefficient on *TT* is unity. The LR test accepts the restriction

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[8] This may be owing to measurement problems, as relative per capita GDP is only a proxy of relative productivity growth.

(χ^2 = 0.13 [p = 0.71]), and the significance of *PROD* also increases somewhat.[9] The final long-run relationship is as follows:

(6) $$REER_t = 0.38PROD_t + TT_t + 0.10NFA_t$$
$$\quad\quad\quad (1.53) \quad\quad\quad\quad (4.64)$$

The estimates suggest that a 10% increase in net foreign assets as a fraction of total exports will lead to a 1% real appreciation in the long run. Assuming a growth adjusted real return of 2.5% on net foreign assets, the estimated coefficient implies that the sum of the price elasticities of real exports and imports should be 1.25, broadly consistent with the estimates for Japan found in the literature.[10] The REER is estimated to have an elasticity of one with respect to the terms of trade. Relative productivity growth is found to have a much less significant impact on the real exchange rate.

The adjustment parameter (α) has a negative sign, and is significant in the dynamic equation for the *REER*, suggesting that the yen has the tendency to revert to its long-run trend value. The adjustment parameters for other variables are either of the wrong sign or insignificant, confirming that in the long run, these variables drive the REER, rather than the other way round.

Based on the established long-run relationship, the trend REER is calculated in the spirit of the Permanent Effective Exchange Rate (PEER) approach. For this purpose, the trend *PROD*, *TT* and *NFA* are derived using the Hodrick-Prescott filter. The actual *REER* and *PEER* are plotted in Chart 3. It indicates that the PEER had an upward trend in the 1980s, but subsequently remained broadly stable. The trend appreciation in the earlier period reflected improvements in the terms of trade and increases in foreign assets (Table 1). In the latter part of the sample period, the downward pressure from a deterioration of the terms of trade was largely offset by the positive effect of the net foreign asset position. Movements in relative GDP per capita played only a small role throughout the sample period.

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[9] Because *PROD* is not highly significant, a VAR without *PROD* is also estimated. The similar empirical procedure yields the following long-run relationship:

$$REER_t = 0.37 + TT_t + 0.10NFA_t$$
$$\quad\quad (13.39) \quad\quad (5.24)$$

The coefficients on *TT* and *NFA* from this specification are almost identical to those from the model with *PROD*. The trend *REER* estimated from this relationship is close to what is derived from the cointegration vector that includes *PROD* (see below).

[10] See, for example, Senhadji (1997), and Senhadji and Montenegro (1998).

Chart 3. Actual and Trend REER
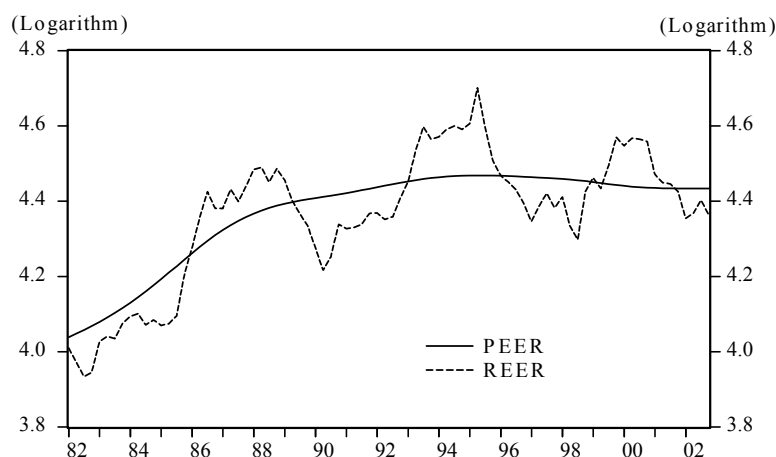
Note: when the dotted line is above the solid line, it is overvaluation. Otherwise, it is undervaluation. The PEER is assumed to take the value of 2001Q4 in 2002.

Table 1. Contribution of Different Factors to Changes in Trend REER

	Contribution (%)			Change in *PEER* (%)
	PROD	*TT*	*NFA*	
1982 Q1 - 1990 Q4	2.6	25.6	9.7	**37.9**
1991 Q1 - 2001 Q4	-2.4	-12.9	16.9	**1.6**

Using the *PEER* as the yardstick, the yen has shown significant swings of undervaluation and overvaluation in real effective terms in the 1990s (Table 2).[11] The largest misalignment occurred between 1993 and in the early part of 1996, during which the yen was overvalued by as much as 23% at one point. Between the second half of 1996 and early 1999, however, the yen adjusted, and fell below its trend immediately before and throughout the Asian financial crisis. This finding lends some support to the view that the weakness of the yen at the time was not justified by economic fundamentals, and may have been a factor contributing to the crisis. The yen appeared to be moderately undervalued by end-2002.

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[11] Interestingly, the episodes of misalignment identified for the yen broadly accord with those from Nagayasu (1998), and to a lesser extent with those from Clark and MacDonald (1998) for overlapping sample periods, even though the two studies differ from the present one in the methodology and samples.

Table 2. Episodes of Misalignment in the Yen

	Misalignment	Estimated misalignment (%)	
		Maximum	Average
1982 Q1 - 1985 Q4	Undervaluation	-13.6	-7.9
1986 Q1 - 1989 Q2	Overvaluation	+13.0	+7.4
1989 Q3 - 1993 Q1	Undervaluation	-19.5	-8.7
1993 Q2 - 1996 Q1	Overvaluation	+23.3	+11.2
1996 Q2 - 1999 Q2	Undervaluation	-15.8	-6.1
1999 Q3 - 2001 Q3	Overvaluation	+12.9	+8.1
2001 Q4 - 2002 Q4	Undervaluation	-7.9	-5.1

Note: Misalignment of the yen in 2002 is calculated based on the assumption that the trend value remained at the 2001Q4 level.

IV. Macroeconomic and Policy Implications

The estimated trend REER could be translated into the more familiar and much watched bilateral yen-dollar nominal exchange rate. This is possible because of a close relationship between the two (Chart 4).[12] Specifically, the trend bilateral nominal exchange rate is derived by applying an estimated relationship between the two in the recent years.[13] This is compared with the actual yen-dollar rate in Chart 5. The trend bilateral exchange rate is estimated to be about 120 per US dollar at present.

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[12] This is not surprising, as trade with the US accounts for around 50% of Japan's total trade and a number of Japan's trading partners explicitly or implicitly peg their currencies against the dollar.

[13] The following relationship is derived using monthly data of the REER and the yen-dollar exchange rate for the period of 1999M1 to 2002M12:
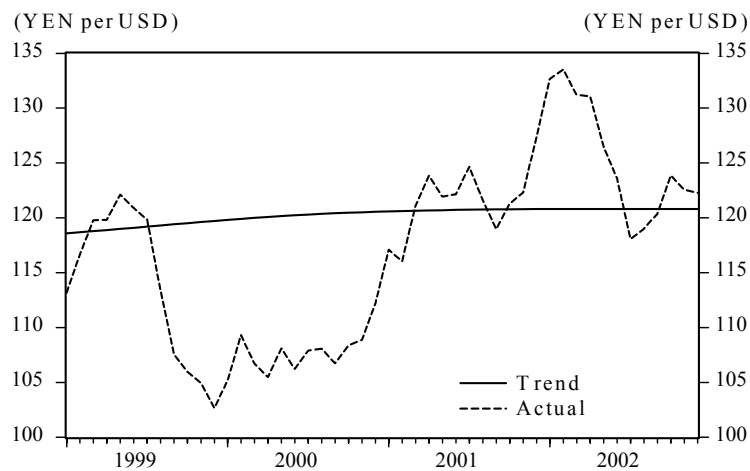
$$REER_t = 9.29 + 1.01 \, s_t$$
$$(20.44)$$

where the bilateral exchange rate s_t is defined as US dollars per yen.

Chart 4. REER and Bilateral Exchange Rate

(1995=100)   (USD per YEN)
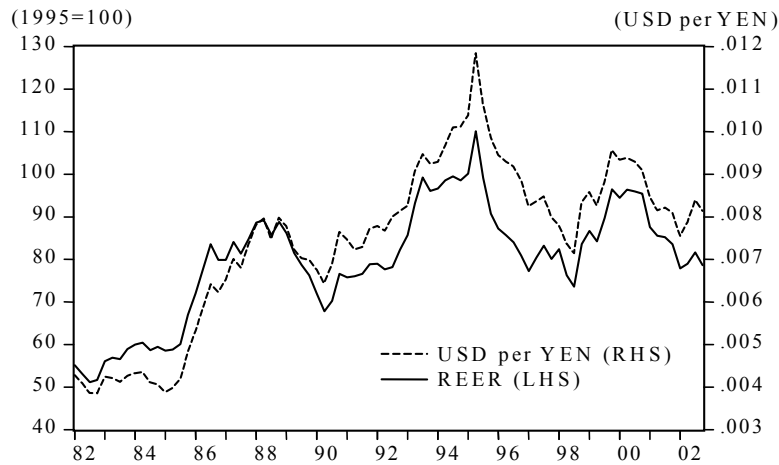
Chart 5. Bilateral Exchange Rate

(YEN per USD)   (YEN per USD)

Note: When the dotted line is above the solid line, the exchange rate is undervalued.

In sum, the estimates support the view that the large net foreign asset position of Japan underpins the strength of the yen. However, there are other factors that may place downward pressure on the yen going forward. Should the deterioration of the relative productivity growth continue, the long-run equilibrium value of the yen would be depressed, other things being equal. In the shorter run, the exchange rate is also affected by factors including relative cyclical conditions in Japan vis-à-vis its main trading partners and the financial market developments. In particular, an increase in the desired level of the NFA position—for example, due to a shock to the relative return of domestic and foreign assets—would require a depreciation to generate more trade surpluses before the new equilibrium is reached. Therefore, the empirical analysis in this study sheds little light on the fundamentals that may influence the yen exchange rate in the short term.

Another important factor is the macroeconomic policies of the Japanese authorities.[14] Intervention by the authorities has helped stem the strengthening of the yen in recent years, as evidenced by the strong rise in the official reserves. There are proposals for the Japanese authorities to use depreciation of the yen as a way out of the liquidity trap. Sustained currency depreciation would stimulate net exports. Furthermore, to the extent that the initial change in the real exchange rate brought about by nominal depreciation is expected to be unwound over time, it would raise inflation expectations. Higher inflation would lower real interest rates, raising domestic demand in Japan. These mechanisms form the basis of Svensson's proposal, which involves an initial large depreciation followed by a nominal exchange rate peg until inflation returns.[15]

It is beyond the scope of this paper to provide an assessment of this proposal.[16] Suffice it to note that it is technically feasible to peg the exchange rate at a depreciated level, as the central bank has an unlimited ability to purchase foreign exchange. However, the required amount of intervention could be potentially very large for two reasons. First, expectations of yen appreciation have become entrenched, in part supported by the strong external payment and net foreign asset position.[17] Secondly, a depreciation may lead to a portfolio re-balancing as the stock of net foreign assets are inflated when measured in the domestic currency. The re-balancing could be particularly significant as the credibility of the policy may be low at the initial stage. This would lead to an upward pressure on the yen as the private sector shifts back to the yen assets. A large-scale intervention to depreciate the yen in the face of a strong external position would be viewed as a "beggar thy neighbour" policy. Strong resistance may come from Japan's main trading partners, particularly the Asian economies.

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[14] Economic policy in Japan's main trade partners—particularly the US—are equally critical. However, this issue is beyond the scope of this study.

[15] Specifically, Svensson suggests that the Japanese authorities should do the following: (1) announce a price level target path, with the target level higher than the current level, and sloping upward over time; (2) announce a devaluation of the exchange rate, and then peg the nominal exchange rate at that level; and (3) intervene with unlimited quantities to hold the nominal exchange rate at that level.

[16] Meredith (2002) provides an empirical assessment of the Svensson proposal. Among other things, he noted a potential time inconsistency in the proposal, which reduces its credibility, especially if it must be carried out over a sustained period of time.

[17] In discussing the predicament of Japan in the 1990s, Krugman (1999, page 79-82) noted the role of the yen exchange rate. He observed that "the reason Japan can be stuck in its trap, despite the ability to invest abroad, is that it cannot get the yen weak enough, even by reducing interest rates to zero". He attributed this to expectations of yen appreciation on investment income that would be received by Japanese residents on their net foreign asset holdings.

Appendix 1. Variable Definitions and Data Sources

The definitions of the variables and sources of the data are listed below.

(a)   Real Effective Exchange Rate: REER

This is the multilateral CPI-based real effective exchange rate of the yen. It is defined in terms of foreign currency per unit of domestic currency, so that an increase in *REER* means appreciation. The variable is expressed in logarithm in estimation.

Source: *International Financial Statistics*, IMF.

(b)   Terms of Trade: TT

The terms of trade is defined as the ratio of unit value index of export to import, both based in 1995. The variable is expressed in logarithm.

Source: calculated based on data from *International Financial Statistics*, IMF.

(c)   Relative Productivity: PROD

Relative productivity between Japan and its trading partners is proxied by the ratio of purchasing power adjusted GDP *per capita* of Japan to the traded-weighted average of purchasing power adjusted GDP *per capita* of its trading partners. The variable is expressed in logarithm.

Source: calculated based on data from *International Financial Statistics* and *the World Economic Outlook Database*, IMF.

(d)   Net Foreign Asset: NFA

Net foreign assets are measured by the difference between asset and liability of the international investment position, and scaled by exports of goods and services in the estimation.

Source: calculated based on data from *International Financial Statistics*, IMF.

Table A. Augmented Dickey-Fuller Test Statistics

	REER	PROD	TT	NFA
Level	-1.66	0.23	-2.24	-0.01
First Difference	-3.87**	-7.50**	-5.09**	-6.03**

Note: ** indicate significance at the 1% level.

Appendix 2. VECM Estimation

(A) Properties of VAR residuals

	REER	*PROD*	*TT*	*NFA*	*VECTOR*
Portmanteau	4.82	0.46	7.07	11.73	75.81
AR	1.16	0.25	1.40	1.14	0.78
Normality	1.53	19.22**	47.32**	6.61*	79.51**
ARCH	0.66	1.60	0.45	0.67	-
Heteroscedasticity	0.63	0.64	0.50	0.75	0.39

(B) Test for the number of cointegrating vectors

$H_0:$	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
λ_i	0.30	0.18	0.09	0.00
TR	51.34*	23.25	7.66	0.14

(C) Long-run relationships

Unrestricted estimates
$$REER_t = 0.33\ PROD_t + 1.08\ TT_t + 0.10\ NFA_t$$
$$\quad\quad (1.35) \quad\quad (6.14) \quad\ (3.98)$$

Restricted estimates
$$REER_t = 0.38\ PROD_t + TT_t + 0.10\ NFA_t$$
$$\quad\quad (1.53) \quad\quad\quad\quad (4.64)$$

Note: Numbers in parentheses ( ) are t-statistics. *, ** indicate significance at the 5% and 1% levels.

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