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ESTIMATING THE NOMINAL YEN/DOLLAR ANCHOR BY APPLYING A LONG-RUN AVERAGING METHOD

This paper presents a way of obtaining a better estimate of the nominal yen/dollar anchor by properly utilizing price-related data. In general, this is estimated by combining the exchange rate between the Japanese yen and the US dollar with the wholesale price index (WPI) or the producer price index (PPI). The reason is that this data is easily available from databases such as International Financial Statistics (IFS) of the International Monetary Fund (IMF). However, these two indices, that is, the WPI of Japan and the PPI of the USA are not based on the same basket, which causes bias for the estimate of a nominal anchor. If we properly utilize the price survey of Input and Output Price Indices (IOPI) from the Bank of Japan (BOJ) and that of Producer Price Index (PPI) from the Bureau of Labor Statistics (BLS), we can hold the similarity of the basket to a large extent. By selecting the price-related data through this procedure and applying a long-run averaging method, the nominal anchor is estimated at 121.93 yen/dollar in February 2002. This value is different from 118.67 yen/dollar that is obtained by utilizing the WPI and PPI related-data. Moreover, the paper makes it clear that the estimated results in the previous studies had the tendency of estimating nominal anchors as of the yen appreciation, owing to the bias of the basket of price indices.*

INTRODUCTION

Estimating an equilibrium exchange rate is one of the most challenging topics in applied economics. For example, Williamson (1994) presented a way of estimating a fundamental equilibrium exchange rate (FEER) based on a current account balance model. However, in general, price-based models such as the ones based on purchasing power parity (PPP) originated by Cassel (1922), are prominent both from the theoretical background and econometric methodology. Kaminsky *et al.* (1998) found that real exchange rates, that is, the nominal exchange rates and international prices based on PPP, were the most significant of the leading indicators of currency crises. Edwards and Savastano (1999), addressing the issue of exchange rates, stressed the role of nominal exchange rate anchors in stabilizing economies.

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Among recent studies, Caporale (2001) showed that empirical support for PPP and an uncovered international parity condition(UIP) could be found within a full-information maximum-likelihood (FIML) framework by testing PPP combined with UIP in a FIML framework. Zumaquero *et al.* (2002), applying error correction models (ECM) with structural breaks to PPP behavior of the exchange rate and international relative prices, found that the predominant adjustment was in the exchange rate with a larger velocity adjustment than in relative prices and that the dynamic adjustment to equilibrium was, in general, stable. Concerning the equilibrium exchange rate between the yen and the dollar, Maurin (2000) developed a model taken into account both the foreign debt and real exchange rate dynamics in response to savings and productivity shocks and deduced an equilibrium exchange rate from the model for the dollar, the yen etc. Borowski and Couharde (2000) estimated equilibrium exchange rates for the euro, the dollar and the yen using a comparative static approach based on the foreign trade equations in the Nigem multicountry model.

The purpose of this paper is to estimate an equilibrium exchange rate based on price criteria. (In this paper, an equilibrium rate based on price criteria is called a nominal anchor.) McKinnon and Ohno (1997), dealing comprehensively with this topic, found that long-run averaging is a robust method for estimating nominal anchors. They provided several estimates of nominal anchors of Japanese yen /US dollar based on PPP. Their estimates are obtained by combining the exchange rate between the Japanese yen and the US dollar with the wholesale price index (WPI) or the producer price index (PPI). This is because this data is easily accessible from well-known databases such as International Financial Statistics (IFS) of the International Monetary Fund (IMF). However, these two indices, that is, the WPI of Japan and the PPI of the USA are not based on the same basket, which causes bias for the estimate of a nominal anchor. If we properly utilize the price survey of Input and Output Price Indices (IOPI) from the Bank of Japan (BOJ) and that of Producer Price Index (PPI) from the Bureau of Labor Statistics (BLS), we can hold the similarity of the basket to a large extent, and then obtain a better estimate of a nominal anchor.

1. THE METHODOLOGY

The standard procedure for estimating nominal anchors follows. The model is based on purchasing power parity (PPP). Assuming negligible

transport costs under perfect competition, the absolute PPP is described as follows:

$$S = \frac{p}{p^*} \tag{1}$$

where S is the nominal exchange rate in Japanese yen / US dollar unit, p is the price of a good in Japan, and p^* is the price of an identical good in the US. This equation does not always hold, in particular when p and p^* are the price indices. These indices do not usually impute the same weights to each good, so equation (1) is rewritten as follows (Equation (2) is usually called the relative-PPP):

$$S = \theta \frac{P}{P^*} \tag{2}$$

Here, P is the price index of the Japanese basket, and P^* is the price index of the US basket. The parameter ($\bullet$) mainly depends upon the base period of the price indices. We adopt a long-run averaging method for estimating.

$$\hat{\theta} = \frac{1}{T} \sum_{k=0}^{T-1} (S_{t-k} P^*_{t-k} / P_{t-k}) \tag{3}$$

where T is the number of samples (years or months) included in the base period. By using the estimate of equation (3), the equilibrium exchange rate of long-run averaging at t period is obtained as follows:

$$S_t^{LA} = \hat{\theta} \frac{P_t}{P_t^*} \tag{4}$$

In selecting the base period to determine the samples of T, no decisive criterion is available. Furman and Stiglitz (1998) rightly pointed out that any base period was necessarily *ad hoc*. In the case of the East Asian currencies, their choice of base period reflected the fact that at least real exchange rates' trends were virtually flat in 1989-91, a period that was also marked by relative macroeconomic tranquillity. However, one can select a base period with reference to the reliability of economic statistics and check it for its stability. If the selected base period is stable in statistical terms, then it warrants the mean reversion to long-run equilibrium. Chinn (1998) followed this methodology and selected January 1975 to December 1996 as the base period for investigating the overvaluation of the East Asian currencies.

This paper focuses on the nominal yen/dollar anchor under the floating exchange rate system after the post-Bretton Woods period. Moreover, a

recent study such as Ramirez and Shahryar (1999) denoted that the high frequency monthly data models did a better job of tracking the turning points of the actual data than the low-frequency quarterly and yearly models in testing PPP hypothesis for five industrial countries including Japan and the USA.

Therefore, it is appropriate to set a base period from March 1973 till the last month. However, the price survey of Input and Output Price Indices (IOPI) from the Bank of Japan (BOJ) started from 1975 and that of the Producer Price Index (PPI) from the Bureau of Labor Statistics (BLS) started from 1978. Specifically, these are the price indices of the general manufacturing industry. Therefore, if we consider the similarity of the baskets, we should select a base period from January 1978 up to the last month. We apply long-run averaging in the January 1978 - February 2002 period. Because of the four-month delay of the data-collecting system of PPI, the 6 March 2002 data of PPI are preliminary at June 2002. We eliminate the preliminary data for the estimation.

2. THE EMPIRICAL RESULTS

First, we should specify P and P^* before estimating equation (4). With respect to price indices, the wholesale price index (WPI) and the producer price index (PPI) are often used as proxy measures covering goods considered to be highly tradable. The reason is the availability of data, which can be easily accessed through IFS (International Financial Statistics) of the IMF (See Engel (1995), McKinnon and Ohno (1997)). However, in estimating the nominal yen/dollar anchor, we can also utilize the BOJ's IOPI as the proxy for P, and the BLS's PPI as the proxy for P^*.

There are several choices of commodity baskets in the WPI, IOPI, and PPI. We can utilize the total wholesale price index (TWPI), the domestic wholesale price index (DWPI), the gross-weighted base input price index of the general manufacturing industry (IPI), and the gross-weighted base output price index of the general manufacturing industry (OPI). With regard to PPI, we also utilize PPI-all commodities (PPI-ac), PPI-intermediate materials, supplies and components (PPI-is), and PPI-finished goods (PPI-fg). Tables 1-2 report part of the contents of the indices. Owing to space, these tables partly indicate contents of WPI and IOPI. See the detail on http://www.boj.or.jp/cn/faq/faqwpi.htm#01. Concerning PPI, see http://www.bls.gov/ppi/ppifaq.htm.

Table 1

The weights of price index (WPI)

	DWPI	XPI	MPI	TWPI
Weights	792.86	119.35	87.79	1,000.00

Base year is 1995. The data sources for calculation of weights are "Census of Manufactures" for 1995, "Trade Statistics" for 1995, etc.
Source: The Bank of Japan.

Table 2

Numbers of adopted commodities

	Numbers of commodities diverted from WPI	Numbers of commodities collected originally for IOPI
Input prices indexes	About 820	About 360
Output price indexes	About 740	About 660

Source:The Bank of Japan.

In general, the choice of (TWPI, PPI-ac), or (DWPI,PPI-ac) has been used well because of the ease of accessing data. But as has been explained in the previous section, this combination does not warrant the same basket of price indices. Rather, the combinations of (IPI,PPI-is), and (OPI,PPI-fg) are plausible proxies of P and P^*, since these are from the same framework of Input and Output Table of Japan and the USA. The industry classification structure organizes products by their industry origin. The industry classification system used is the SIC (Standard Industrial Classification) system of 4-digit industry codes. In addition, we can easily utilize these data from the BOJ and BLS sites. IPI and OPI data can be obtained from (http://www.boj.or.jp/en/siryo/siryo-f.htm). (PPI-is) and (PPI-fg) data can be obtained from (http://www.data.bls.gov/cgi-bin/surveymost?pc).

Second, we need to check the mean reversion of the real exchange rate. We conduct a cointegration test for three variables: the nominal yen/dollar exchange rate (S), the price of a Japanese widget (P), and the price of a US widget (P^*) in order to confirm the stationarity. In this paper, we just only confirm the mean reversion in standard cointegration framework. Although we can develop other cointegration tests such as structural cointegration or ECM etc., these analytical frameworks are slightly different from the long-

run averaging method. For example, the definition of long run in this paper is given in equation (3) and (4), which is different from the one in cointegration or ECM framework. The main purpose of this paper is to apply price-related data properly, not to apply econometric methodology. Therefore, we hold to report a preliminary result of mean reversion. Table 3 reports the result of various combinations of (P,P^*), and the null hypothesis of no cointegration and that of one cointegration are rejected in all cases at the 1% significance level. Thus, we can confirm the mean reversion of the real exchange rate in the selected period.

Table 3

Cointegration trace test statistics

(P, P*)	Optimal lags	r=0	r=1	r=2
(TWPI,PPI-ac)	4	57.39**	26.82**	4.79*
(DWPI,PPI-ac)	4	60.02**	29.09**	6.38*
(IPI,PPI-is)	3	54.24**	28.93**	6.44**
(OPI,PPI-fg)	4	60.41**	29.40**	1.71

Notes: Sample period is January 1978 to February 2002. Double asterisks (**) and a single asterisk (*) indicate that the test statistics are significant at the 1% and 5% levels, respectively.
Source: own calculation

Table 4

Estimated yen/dollar nominal anchors (February 2002)

P/P*	TWPI/PPI-ac	DWPI/PPI-ac	IPI/PPI-is	OPI/PPI-fg
Estimated rates	118.67	121.56	127.64	121.93

Note: Sample period for estimating long-run averaging is January 1978–February 2002. T(sample size) = 278.
Source: own calculation

Table 4 gives the estimated result of nominal yen/dollar anchors by applying long-run averaging. The combinations of commodity basket are in turn (TWPI, PPI-ac), (DWPI, PPI-ac), (IPI, PPI-is), and (OPI, PPI-fg). While

input price indices are composed of raw materials and intermediate material for imports and domestic products, output price indices are composed of intermediate material and final goods for domestic products and exports. Therefore, the combination of (OPI, PPI-fg) is more suitable than the one of (IPI, PPI-is) for the concept of tradability, as advocated by Harrod (1953) and McKinnon (1979). According to the estimation, the nominal anchor of 121.93 yen/dollar is the long-run averaging equilibrium rate. If we set a target zone as the wider bound of the anchor ± 5%, as McKinnon and Ohno (1997) advocated, then the zone is 121.93±6.09, or 115.84-128.02.

Moreover, if we compare the estimates applied by (OPI,PPI-fg) with those by (TWPI,PPI-ac), we can find that the former consistently denote the yen depreciation as of 3-5 yen/dollar to the latter from September 2001 to February 2002. Table 5 presents the comparison of two estimates. This means that the estimated results in the previous studies such as McKinnon and Ohno (1997) have the tendency of overestimating the values of yen, owing to the bias of the basket of price indices.

Table 5

The comparison of (TWPI/PPI-ac) and (OPI/PPI-fg)

Month/year	TWPI/PPI-ac	OPI/PPI-fg	Difference
September 2001	113.90	118.58	4.68
October 2001	116.16	119.94	3.78
November 2001	115.97	120.81	4.84
December 2001	118.49	122.00	3.51
January 2002	118.52	121.86	3.34
February 2002	118.67	121.93	3.26

Source: own calculation

CONCLUSION

The present paper illustrated a way of obtaining better estimates of a nominal yen/dollar anchor by properly utilizing, as price-related data, the WPI and IOPI of the BOJ, and the PPI of the BLS. In general, nominal anchors have been estimated by combining the exchange rate between the Japanese yen and the US dollar with the wholesale price index (WPI) or the producer price index (PPI). The reason is the ease of accessing databases

such as International Financial Statistics (IFS) of the International Monetary Fund (IMF). However, these two indices, that is, the WPI of Japan and the PPI of the USA are not based on the same basket, which causes bias for the estimate of a nominal anchor. If we properly utilize the price survey of Input and Output Price Indices (IOPI) from the Bank of Japan (BOJ) and that of Producer Price Index (PPI) from the Bureau of Labor Statistics (BLS), we can hold the similarity of the baskets to a large extent. By selecting price-related data through this procedure and applying a long-run averaging method, the nominal anchor was estimated as 121.93 yen/dollar in February 2002. This value was different from 118.67 yen/dollar which was obtained by using the WPI and PPI related-data. Moreover, the paper made it clear that the estimated results in the previous studies such as McKinnon and Ohno (1997) had the tendency of overestimating the values of yen, owing to the bias of the basket of price indices.

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REFERENCES

Borowski, Didier, Couharde, Cecile. 2000. Euro, dollar, yen: Pour une approche multilaterale des taux de change d'equilibre. (The Equilibrium Exchange Rates of the Euro, the Dollar and the Yen. With English summary). *Revue Economique* vol 51. No. 3 pp. 671-81.

Caporale, Guglielmo Maria, Kalyvitis, Sarantis , Pittis, Nikitas . 2001. Testing for PPP and UIP in an FIML Framework: Some Evidence for Germany and Japan. *Journal of Policy Modeling* vol.23, No. 6 pp. 637-50.

Cassel, G. 1922. *Money and Foreign Exchange After 1914.* Macmillan, New York.

Chinn, M. 1998. Before the fall: Were East Asian currencies overvalued? *NBER Working Paper* #6491.

Edwards, S. , Savastano, M. 1999. Exchange rates in emerging economies: What do we know? What do we need to know? *NBER Working Paper* #7228.

Engel, C. 1995. Accounting for US real exchange rate changes. *NBER Working Paper* #5394.

Furman, J. , Stiglitz, J.E. 1998. Economic crises: Evidence and insights from East Asia. *Brookings Papers on Economic Activity* 2, 1-135.

Harrod, R.F. 1953. *International Economics.* University of Chicago Press, Chicago.

Kaminsky, G., Lizondo, S., Reinhart, C.M. 1998. Leading indicators of currency crises. *IMF Staff Papers* 45, 1-48.

Maurin, Laurent. 2000. La modelisation des taux de change d'equilibre et leur estimation pour l'euro, le dollar et le yen. (Modeling Equilibrium Exchange Rates and Estimating them for the Euro, Dollar and Yen. With English summary.). *Economie et Prevision* No. 142. pp. 1-11.

McKinnon, R. I. 1979. *Money in International Exchange.* Oxford University Press, New York.

McKinnon, R. I., Ohno, K. 1997. *Dollar and Yen.* MIT Press, Cambridge.

Morales Zumaquero, Amalia , Peruga Urrea, Rodrigo. 2002. Purchasing Power Parity: Error Correction Models and Structural Breaks. *Open Economies Review* vol. 13, No. 1 pp. 5-26.

Ramirez, Miguel D. , Khan, Shahryar. 1999. A Cointegration Analysis of Purchasing Power Parity: 1973-96. *International Advances in Economic Research* vol. 5, No. 3 pp. 369-85.

Williamson, J. (ed.) 1994. *Estimating Equilibrium Exchange Rates.* Institute for International Economics, Washington, DC.

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