2012-E-2

*Bank of Japan Review*

# Changes in the Relationship between Currencies and Commodities

Financial Markets Department
Haruko Kato

March 2012

This paper examines the relationship between so-called commodity currencies and commodity prices in recent years. Commodity prices have fluctuated significantly during this time period. Commodity currencies -- the currencies of large commodity exporters such as Australia, Canada, Chile, and South Africa -- have experienced large swings together with commodity prices. The paper identifies the basis of the co-movements between commodity currencies and commodity prices, and checks the statistical data to see whether there are any changes in the relationship between commodity currencies and commodity prices. The results show that commodity currencies have developed a stronger relationship with major commodity indexes rather than with the unique commodities the countries produced. In addition, it is found that commodity currencies used to have forecasting power in terms of commodity prices, but have lost that power in the course of the "financialization" of commodities. These changes may cause higher volatility in both markets and hence should be kept in mind in the monitoring of international financial markets.

## Introduction

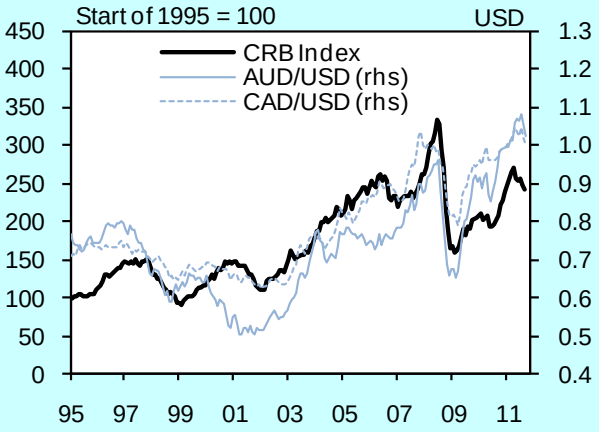
From the start of 2009, commodity prices[1] rose against the backdrop of growing physical demand in emerging economies and accommodative global monetary conditions.[2] Commodity prices trended upward until the second quarter of 2011, when they began to decline in line with the deteriorating global economic outlook and lower risk appetite due to the European sovereign debt crisis.

Commodity currencies[3] -- the currencies of large commodity exporters such as Australia, Canada, Chile, and South Africa -- have moved together with commodity prices. The foreign exchange rates of these currencies against the U.S. dollar rose in value by a greater percentage than other major currencies from the start of 2009, until they began to decline in the second quarter of 2011.

The co-movement between commodity currencies and commodity prices is not a recent phenomenon, but has been observed since at least 1995, when data sets became available (Chart 1).

In general, when commodity prices go up, the net exports of commodity-exporting countries increase, the terms of trade become more favorable for these countries, and their currencies rise in value.[4] The co-movement between the commodity currencies and commodity prices is basically founded on this fundamental background.

Chart 1: Commodity Currencies and the Commodity Index



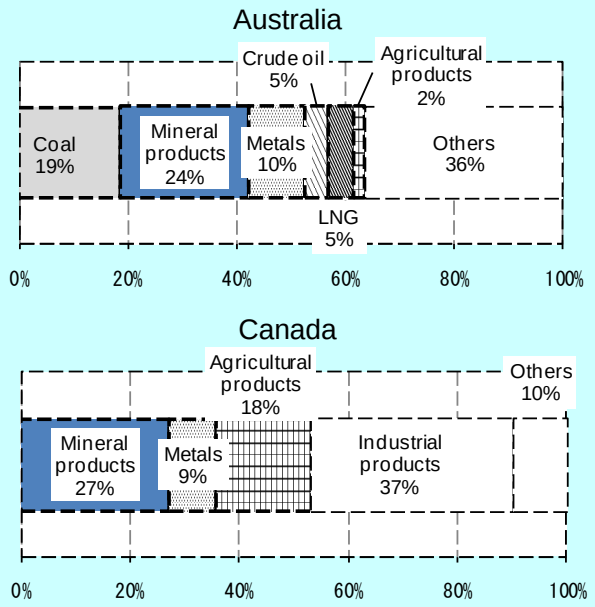

Source: Bloomberg.

For example, in Australia and Canada the share of raw commodities in exports accounts for more than half of the total (Chart 2). An increase in net exports and more favorable terms of trade should positively affect economic growth in these countries.

However, in recent years market participants have observed that the movements of commodity

currencies are more reactive to major commodity indexes than to the "fundamentals" of commodity-exporting countries.

Chart 2: Share of Raw Commodities in Exports




Note: As of 2010.
Source: JETRO.

Since the mid-2000s, financial investors' participation in commodity-related financial markets has grown significantly and commodity markets have undergone "financialization." It has been pointed out that the financialization of commodity markets may drive up commodity indexes to a higher level than that suggested by the fundamentals and thus increase the risk of a sharp decline in the future.

If the commodity currencies have developed a stronger relationship with commodity indexes, this may also increase the risk of a sharp decline in commodity currencies.

The changes in the relationship between commodity currencies and commodity prices should therefore be seen as an important consideration in the monitoring of international financial market stability. Accordingly, this paper identifies the basis of the co-movements between commodity currencies and commodity prices, and checks the statistical data to see whether there are any changes in the relationship between commodity currencies and commodity prices.

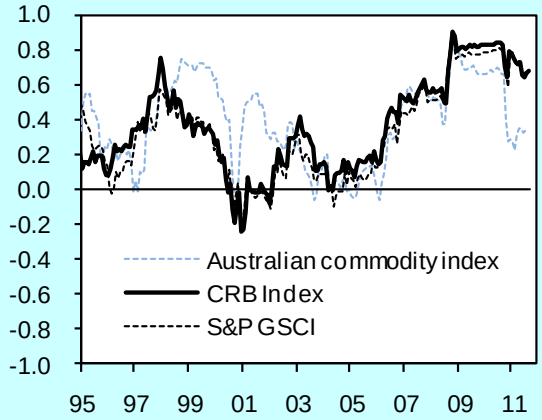
## Co-Movement between Commodity Currencies and Commodity Prices

Given that the co-movement between commodity currencies and commodity prices should be based on a fundamental phenomenon resulting from an increase or decrease in net exports, it is natural to assume that a commodity currency correlates with the prices of the commodities produced in or exported by that country. In this paper, a unique commodity index is constructed for each commodity exporter by calculating the weighted average[5] of the prices of the commodities exported by the country to determine the correlation between a commodity currency and each commodity index.

Chart 3 is a time-series chart showing the correlation coefficient over time between the Australian dollar (AUD), a major commodity currency, and each commodity index: the CRB Index, the S&P GSCI, and the Australian commodity index.

According to the chart, the correlation between the AUD and the commodity indexes increased from the mid-2000s across the board. Following the Lehman shock, the correlation between the AUD and major global commodity indexes (the CRB Index and the S&P GSCI) remained at a high level, while that between the AUD and the Australian commodity index decreased sharply.[6]

Chart 3: Correlation between the AUD and Commodity Indexes



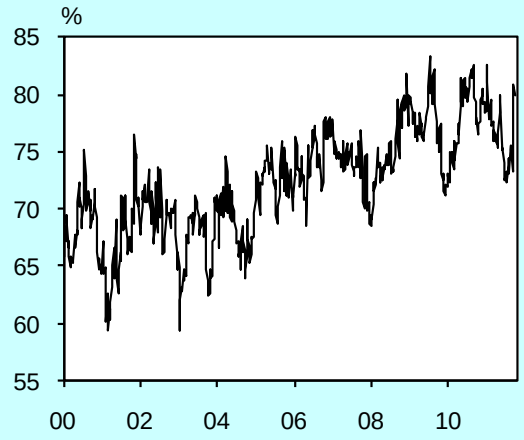

Note: Rolling 2-year correlation coefficient of monthly returns.
Source: Bloomberg.

The high correlation between the commodity currencies and the major global commodity indexes can be explained by two factors.

The first is the increase in commodity index investment due to financialization of the commodity markets.[7] Given the boom in index investment, the correlation rose among major commodities -- especially among indexed commodities (Chart 4) -- while the correlation among off-indexed commodities remained at a relatively low level. The commodity indexes mainly reflect the risk appetite of investors or their expectations about the values of the future fundamentals, while the off-indexed commodity

prices mainly reflect the unique supply-demand balance of the commodity.

Chart 4: Co-Movements between Prices of Major Commodities




Note: Co-movements between the prices of 16 major commodities for the past 50 weeks.
Source: Bloomberg.

As a result, the major commodity indexes gained a higher correlation with commodity currencies, which are asset prices and tend to incorporate expectations about the future fundamentals.

The second is a boom in algorithmic trading in foreign exchange markets. The boom in such markets of real-time algorithmic trading focused on co-movements between different products has reinforced the cross-product correlation.

These factors, both of which have been accelerated by the increased inflows to commodity indexes, have resulted in a stronger correlation between commodity indexes and commodity currencies than that suggested by the fundamentals.

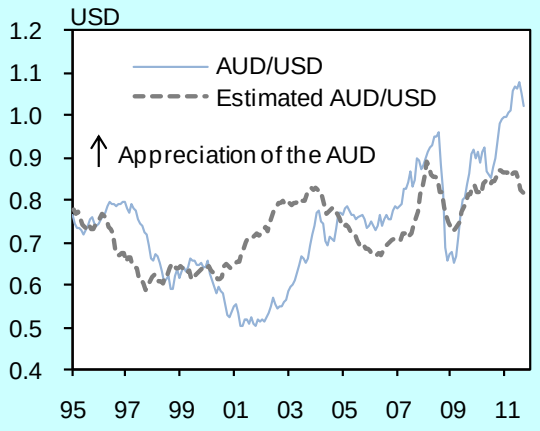
Chart 5 shows the relationship between the AUD and an interest rate differential (the 2-year government bond rate in Australia minus the 2-year government bond rate in the United States). The changes in fundamentals in Australia and the United States should be reflected in expectations about future policy interest rates in these countries and hence in the interest rate differential. If movements of the foreign exchange rate deviate greatly from movements of the interest rate differential, the foreign exchange rate can be seen to have deviated from the fundamental factors. Although this is a simple estimation, it is notable that the AUD has been on an upward trend and exceeded the level estimated by the interest rate differential following the Lehman shock. This occurred about the same time that the AUD strengthened its correlation with major commodity indexes rather than with the unique commodities produced in Australia.

## Forecasting Power of Commodity Currencies over Commodity Prices

This paper also checks the time lags between commodity currencies and commodity prices. Given that the movements of commodity currencies are based on the fundamentals such as growth in net exports and favorable terms of trade, commodity currencies should lag behind commodity prices.

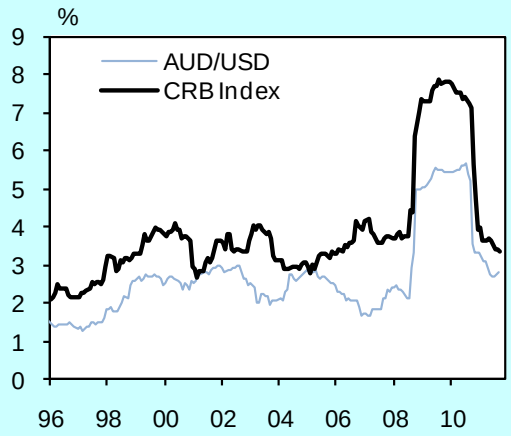
However, Chen, Rogoff, and Rossi (2010) checked the time lags between commodity currencies and commodity prices by using quarterly data up to 2008/1Q, and pointed out that "commodity currencies have surprisingly robust power in predicting global commodity prices." They explained that since the nominal exchange rate can be an asset price, it

Chart 5: AUD Estimated by an Interest Rate Differential




Note: Monthly data. Simple estimation using the 2-year government bond rate differential for the period from 1995.
Source: Bloomberg.

Chart 6: Volatilities of the AUD and the Commodity Index




Note: Rolling 2-year volatilities of monthly returns.
Source: Bloomberg.

incorporates expectations about the values of its future fundamentals, such as commodity prices (see the Box).

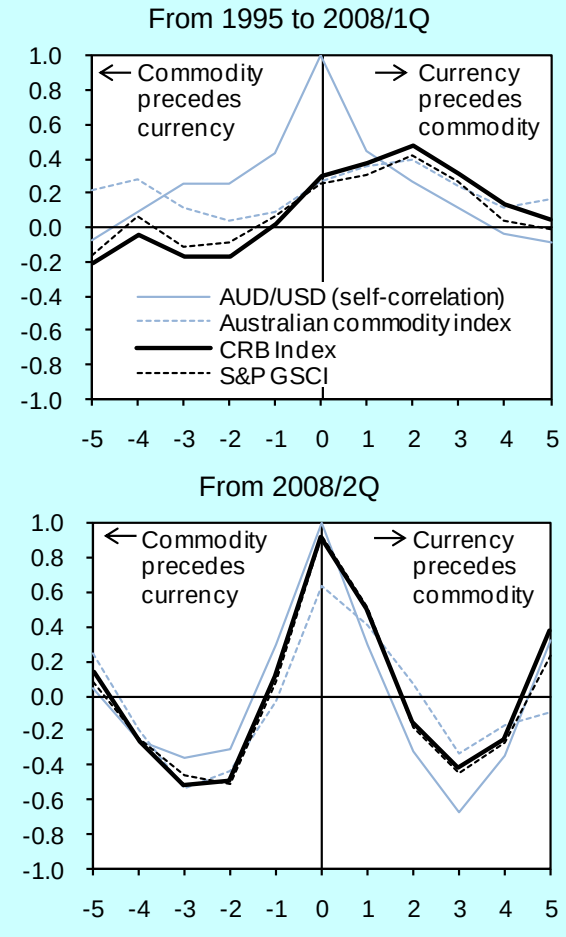
In addition, they pointed out that the difference in market structures contributes to the forecasting power of currencies. They noted that market participants in foreign exchange markets foresee future commodity shocks and their expectations will be priced into current exchange rates. In contrast, commodity prices tend to be quite sensitive to current global market conditions, as both demand and supply are typically quite inelastic.

In fact, the volatility of the AUD, one of the major commodity currencies, is basically lower than that of a major commodity index (Chart 6).

However, in recent years, the relationship may have changed. Accordingly, the forecasting power of commodity currencies is checked by calculating lagged correlations between commodity currencies and commodity indexes.

Chart 7 shows the lagged correlation coefficient between the AUD and commodity indexes. It shows that up to 2008/1Q the AUD preceded the commodity indexes by approximately two quarters. The commodity currency seemed to have forecasting power over commodity prices. However, from 2008/2Q the correlation coefficient between the AUD and commodity indexes peaked with no time lags. This implies that the commodity currencies have lost their forecasting power over commodity prices.[8]

Chart 7: Lagged Correlation Coefficient of the AUD and Commodity Indexes




Note: Quarterly data.
Source: Bloomberg.

## Conclusion

In this paper, it was shown that (1) the commodity currencies have developed a stronger relationship with the major commodity indexes than with the unique commodities produced in the commodity-exporting countries, and (2) commodity currencies used to have forecasting power over commodity prices but have lost that power. These changes are related to the "financialization" of commodities and rapid growth of algorithmic trading in foreign exchange markets.

In recent years, financial investors' participation in commodity index investment or other commodity-related derivatives transactions has grown significantly. In line with the growth in commodity index investment the correlation has risen among the major commodities (especially among indexed commodities), whereas that among the minor commodities (especially among off-indexed commodities) has remained at a lower level. This implies that the price of major commodities tends to reflect the expectations of future fundamentals or the risk appetite of market participants, while the price of minor commodities tends to reflect unique factors such as the supply-demand balance of commodity producers and end-users. As a result, the major commodity indexes have gained a stronger, real-time correlation with commodity currencies.

The other reason for the changed relationship between commodity currencies and commodity prices is algorithmic trading in foreign exchange markets. Some traders focus on cross-product relationships and construct their positions by embedding real-time price movements of other products. For example, it has been pointed out that some commodity currency-traders embed commodity prices in their algorithms.

These changes can make either commodity prices or commodity currencies diverge from the fundamentals and increase the risk of a sharp unwinding. In fact, the volatility of the AUD has

remained at a relatively high level in recent years (Chart 6). In the monitoring of international financial markets, therefore, the risk of large swings in commodity currencies and commodity prices should be watched carefully.

## Box: Forecasting power of the foreign exchange rate

The foreign exchange rate, reflecting the expectations of numerous market participants regarding future economic conditions, is often considered to be a barometer of future developments. In fact, according to uncovered interest parity, the condition below should be fulfilled if there is no arbitrage. Here, $i$ is an interest rate in a commodity-exporting country, $i^*$ is an interest rate in the United States, and $S$ is the exchange rate of a commodity currency against the U.S. dollar.

$$1 + i_t^* = \frac{S_{t+1}}{S_t}(1 + i_t). \qquad (1)$$

The left-hand side shows the expected return gained by asset investment in the United States. The right-hand side shows the expected return in U.S. dollars gained by asset investment in the commodity-exporting country.

By sequential substitution of (1) into $S_{t+1}$, the equation below is obtained.

$$S_t = \frac{(1 + i_t)(1 + i_{t+1})(1 + i_{t+2}) \ldots (1 + i_{t+\infty})}{(1 + i_t^*)(1 + i_{t+1}^*)(1 + i_{t+2}^*) \ldots (1 + i_{t+\infty}^*)} S_\infty. \qquad (2)$$

The numerator on the right-hand side shows the expected fundamentals for the commodity-exporting country, while the denominator on the right-hand side shows the expected fundamentals for the United States. $S_\infty$ is the expected exchange rate for the infinitely distant future, which can be considered as a constant.

Equation (2) shows that if an expectation is ameliorated concerning the future fundamentals in the commodity-exporting country, then the exchange rate of the commodity currency against the U.S. dollar will jump upward.

In actual movement of the foreign exchange rate, the jump indicated in equation (2) would repeatedly occur parallel with the change in expectation about fundamentals.

It should be noted that the future trend for the exchange rate is shown in equation (1). If the fundamentals of the commodity-exporting country are superior to those of the United States (if the interest rate in commodity-exporting countries is higher than that of the United States), then the exchange rate of the commodity currency should depreciate. The relationship expressed in equation (1) is not always fulfilled in the short term, but it should be fulfilled in the long run. For example, in the mid-2000s, when the so-called carry trade in foreign exchange markets was growing rapidly, the exchange rate of a high-interest-rate country such as Australia trended upward for a few years until a large unwinding of positions occurred.

[1] This paper uses the Thomson Reuters/Jefferies Commodity Research Bureau (CRB) Index and Standard & Poor's Goldman Sachs Commodity Index (S&P GSCI) as the major international commodity indexes. These indexes have different weights for individual commodities. The CRB Index puts a larger weight on agricultural products, while the S&P GSCI puts a larger weight on energy.

[2] For details, see Yasunari Inamura, Tomonori Kimata, Takeshi Kimura, and Takashi Muto, "Recent Surge in Global Commodity Prices -- Impact of Financialization of Commodities and Globally Accommodative Monetary Conditions," Bank of Japan Review Paper No. 2011-E-2, Bank of Japan.

[3] This paper uses the currencies of Australia, Canada, Chile, and South Africa along the lines of Yu-chin Chen, Kenneth S. Rogoff, and Barbara Rossi, "Can Exchange Rates Forecast Commodity Prices?" *Quarterly Journal of Economics*, Vol. 125, No. 3, pp. 1145-1194, 2010.

[4] This trend could negatively impact a country's exports, a phenomenon known as "Dutch disease."

[5] The weight used by Chen, Rogoff, and Rossi (2010) is adopted.

[6] Similar results were obtained for other commodity currencies.

[7] For details, see Ke Tang and Wei Xiong, "Index Investment and Financialization of Commodities," NBER Working Paper No. 16385, National Bureau of Economic Research, 2010.

[8] Consistent results were obtained in Granger causality tests for commodity currencies and commodity prices, as shown below.

From 1980 to 2008/1Q:

| | AUD | CAD | ZAR | CLP |
|---|---|---|---|---|
| $H_0: \beta_0 = \beta_1 = 0$ in $\Delta CP_{t+1} = \beta_0 + \beta_1 \Delta S_t + \beta_2 \Delta CP_t$ | | | | |
| $p$-values | 0.64 | 0.85 | 0.85 | 0.41 |
| $H_0: \beta_0 = \beta_1 = 0$ in $\Delta S_{t+1} = \beta_0 + \beta_1 \Delta CP_t + \beta_2 \Delta S_t$ | | | | |
| $p$-values | 0.02 ** | 0.00 *** | 0.05 * | 0.01 ** |

From 2005:

| | AUD | CAD | ZAR | CLP |
|---|---|---|---|---|
| $H_0: \beta_0 = \beta_1 = 0$ in $\Delta CP_{t+1} = \beta_0 + \beta_1 \Delta S_t + \beta_2 \Delta CP_t$ | | | | |
| $p$-values | 0.98 | 0.79 | 0.83 | 0.06 * |
| $H_0: \beta_0 = \beta_1 = 0$ in $\Delta S_{t+1} = \beta_0 + \beta_1 \Delta CP_t + \beta_2 \Delta S_t$ | | | | |
| $p$-values | 0.39 | 0.69 | 0.46 | 0.01 ** |

Note: The asterisks indicate rejection at the 1 percent (***), 5 percent (**), and 10 percent (*) significance levels, respectively. *CP* denotes commodity price index. Here the commodity index calculated by the IMF is used, along the lines of Chen, Rogoff, and Rossi (2010). *S* denotes the foreign exchange rate against the U.S. dollar for each country. CAD, ZAR, and CLP denote the Canadian dollar, South African rand, and Chilean peso, respectively.

The *Bank of Japan Review* is published by the Bank of Japan to explain recent economic and financial topics for a wide range of readers. This report, 2012-E-2, is a translation of the original Japanese issue, Bank of Japan Review Paper No. 2011-J-12, published in December 2011. The views expressed in the Review are those of the author and do not necessarily represent those of the Bank of Japan. If you have comments or questions, please contact Financial Markets Analysis Group, Coordination and Market Analysis Division, Financial Markets Department (Tel: +81-3-3279-1111). The *Bank of Japan Review E-series* and the *Bank of Japan Working Paper E-series* can be obtained through the Bank of Japan's web site (http://www.boj.or.jp).