Supplementary Note 1　Estimation of the fluctuating factors of the prices of crude oil, copper, wheat and corn

We execute estimations of the fluctuating factors of the prices of 4 commodities of crude oil, copper, wheat and corn using following VAR model composed by 2 variables of stock and price.

(1) Formula of the estimation

$$y_t = R_1 \ y_{t-1} + u_t \qquad \text{(VAR model)}$$

y_t : Comparison of the world stock year-on-year
log (price)

Note: When it comes to wheat and corn, we compare the global total of estimated value of the final stock amount at the end of the month of market year in each country (monthly updated) with the final stock amount at the end of month in the previous year.

R_1: 2×2 matrix concerning parameters of VAR model

U_t: Error term

We make the length of lag to be 1 term based on the standard of data amount.

(2) Decomposition of　price fluctuation

Using the estimated VAR model parameters,　the fluctuations of prices of 4 commodities are decomposed into 3 factors – (a) Trend factor (price fluctuation when stock shock and price shock are zero), (b) Supply-demand factor other than trend (change in stock caused by change in supply-demand conditions due to other than trend that contributed to price fluctuation), (c) random price fluctuation that can't be explained by trend factor and supply-demand factor out of trend (we define (b) and (c) as "part that can't be explained by only supply-demand balance").　Denoting the time when the price hike started as t-k enables the decompositions of the following changes.

$$\begin{aligned} y_t &= R_1 \ y_{t-1} + u_t \\ &= R_1 (R_1 \ y_{t-2} + u_{t-1}) + u_t \\ &= R_1 (R_1 (R_1 \ y_{t-3} + u_{t-2}) + u_{t-1}) + u_t \\ &= \cdots\cdots \\ &= R_1^k \ y_{t-k} + R_1^k \ u_{t-k} + \cdots + R_1 \ u_{t-1} + u_t \end{aligned}$$

$R_1^k \ y_{t-k}$: (a) Trend factor

$R_1^k \ u_{t-k} + \cdots + R_1 \ u_{t-1} + u_t$: (b) Supply-demand factor other than trend and (c) random price fluctuation that can't be explained by trend factor and supply-demand factor out of trend

(3) Estimation term

From Jan. 2002 to Dec. 2010 (copper, wheat and corn)

From Jan. 2001 to Dec. 2010 (crude oil)

(4) Estimation result

(A) Estimation result of VAR model

Supplementary Note Table 1-1 shows the result of measuring of VAR model that stock data and price data of each commodity are applied. Over all t-values, the variables of price with lag 1 are low, but satisfy the claimed sign condition (minus). Determination-coefficient is good.

Supplementary Note Table 1-1 Estimation result of VAR model

Commodities	Explained variable	Explanatory variable		Determination coefficient (R-squared)
		Stock (-1)	Price (-1)	
Crude oil	Stock	0.881 (12.094)	-0.0003 (-0.345)	0.55
	Price	0.199 (1.286)	1.001 (467.38)	0.97
Copper	Stock	0.929 (26.93)	0.0009 (0.258)	0.87
	Price	0.009 (0.938)	1.002 (1002.55)	0.98
Wheat	Stock	0.917 (25.67)	0.0023 (0.506)	0.86
	Price	-0.0067 (-1.621)	1.007 (194.06)	0.95
Corn	Stock	0.938 (28.41)	0.0003 (0.046)	0.88
	Price	0.0033 (0.126)	1.008 (158.32)	0.95

(Note) Figures in parenthesis is t-value.

(B) Decomposition results for price fluctuation

Supposing the timing of start of price hikes as Jan. 2004 for crude oil and copper, and Aug. 2006 for wheat and corn, we decompose of price fluctuation after that time.

As the result, price level at the time of Dec. 2010 due to changes in stock amounts are around as follows – crude oil: $45.3/BBL (actual price is $89.2/BBL), copper: $5,947/Mt (actual price is $9,153/Mt), wheat: $4.2/bu (actual price is $7.6/bu), corn: $3.7/bu (actual price is $5.9/bu).

(5) Data set

Crude oil price: Data of NYMEX

Price and stock amount of copper: Data of LMX

Prices of wheat and corn: Data of CBOT

Stock amount of crude oil: Total of monthly data of the U.S.A (API/Monthly Statistical Report), Britain (DTI/Energy Trend), Germany (BAFA/Amtliche Mineraloldaten), France (IEA/Monthly Oil & Gas Survey).

Stock amount of wheat: "World Agricultural Supply and Demand Estimates" of USDA

Stock amount of corn: "Grain：World Markets and Trade" of USDA