(Box 4) Effects of Exchange Rates on the CPI

The recent increasing pace of the rise in the CPI (all items less fresh food and energy, the same hereafter) is largely attributable to the rise in prices of items of which imported goods have a considerable share, such as food products, durable goods, and clothes (Box Chart 6 [1]).   In light of this fact, some often argue that, as the recent improvement in the CPI is mostly supported by the effects of yen depreciation, it will decelerate sooner or later given that the pace of the depreciation has stalled recently.   However, the prices of such items as food products, durable goods, and clothes are responsive not only to the effects of exchange rates, but also to economic activity; thus, the effects of exchange rates on the rise in the CPI should be quantitatively sorted out, taking account of the effects of macroeconomic factors such as the output gap and inflation expectations.   In other words, in order to assess the impact of exchange rate movements in the current phase -- i.e., that excessive appreciation of the yen has been corrected and thus the yen has depreciated -- it is important to differentiate the first-round pass-through, which is the direct effects of exchange rates on the CPI, from the full pass-through, which includes the effects through indirect channels such as the improvement in the output gap and inflation expectations.

Previous studies suggest that the first-round pass-through on the CPI tends to be small, with the exception of that on energy prices.   If the Phillips curve with exchange rates added to explanatory variables is estimated, the coefficient of the nominal effective exchange rate is relatively small at 0.10 (Box Chart 7 [1]).   If the contribution of exchange rates on the year-on-year rate of increase in the CPI is calculated based on this estimation (indicated as the "Single Equation Approach" in Box Chart 6 [2]), it has been moderately dissipating after peaking in the middle of fiscal 2014 and is currently at around 0.2 percentage point. Looking ahead, based on this estimation result, if it is assumed that the nominal effective exchange rate will continue to be flat, the contribution of yen depreciation to the CPI is calculated as shrinking moderately, even though it will remain toward the end of fiscal 2016.
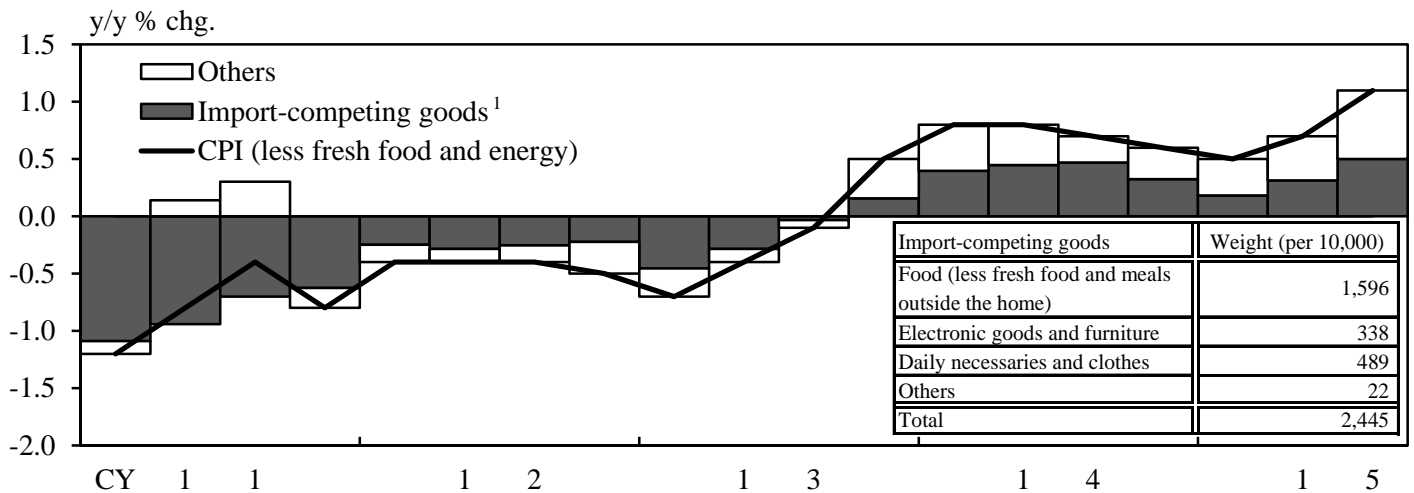
On the other hand, the effects of the full pass-through are considered to be substantially large and persistent.   In the estimated trivariate VAR (vector auto-regression) model

consisting of the nominal effective exchange rate, the output gap, and the CPI, which incorporates the lag structure of the macroeconomic variables and their interdependence, the effects of a 10-percent yen depreciation shock on the CPI is calculated to be larger and more persistent, compared with the first-round pass-through effects estimated by Single Equation Approach, reflecting indirect effects such as the improvement in the output gap and the rise in (backward-looking) inflation expectations (Box Chart 7 [2]). If the year-on-year rate of increase in the CPI is decomposed into the contributions of fundamental factors by using the results of this VAR estimation (i.e., historical decomposition), the depreciation of the yen has been very persistently pushing up the CPI since the second half of 2013, and it currently stands at 0.5-1.0 percentage point (Box Chart 6 [3]).[40] This is considered to be attributable to indirect effects -- the improvement in the output gap and inflation expectations triggered by yen depreciation -- having persistently pushed up the CPI, in addition to a cost-push factor; namely, that the depreciation has directly pushed up import prices. Looking ahead, if this point is taken into account, the past depreciation of the yen will continue to have the persistent effect of pushing up the CPI.
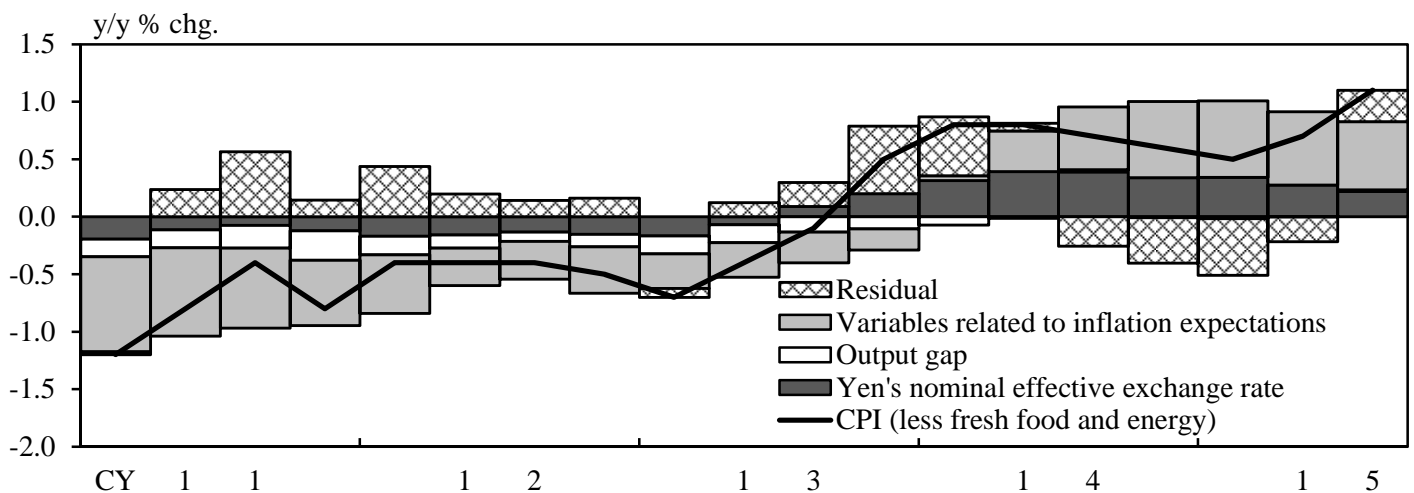
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[40] The historical decomposition based on VAR quantitatively reveals the indirect effects of a fundamental shock through other variables. Accordingly, the contribution of the exchange rate shock in this analysis includes changes in the CPI through the transmission channel where yen depreciation induced the improvement in the output gap and inflation expectations, thereby leading to the rise in the CPI.
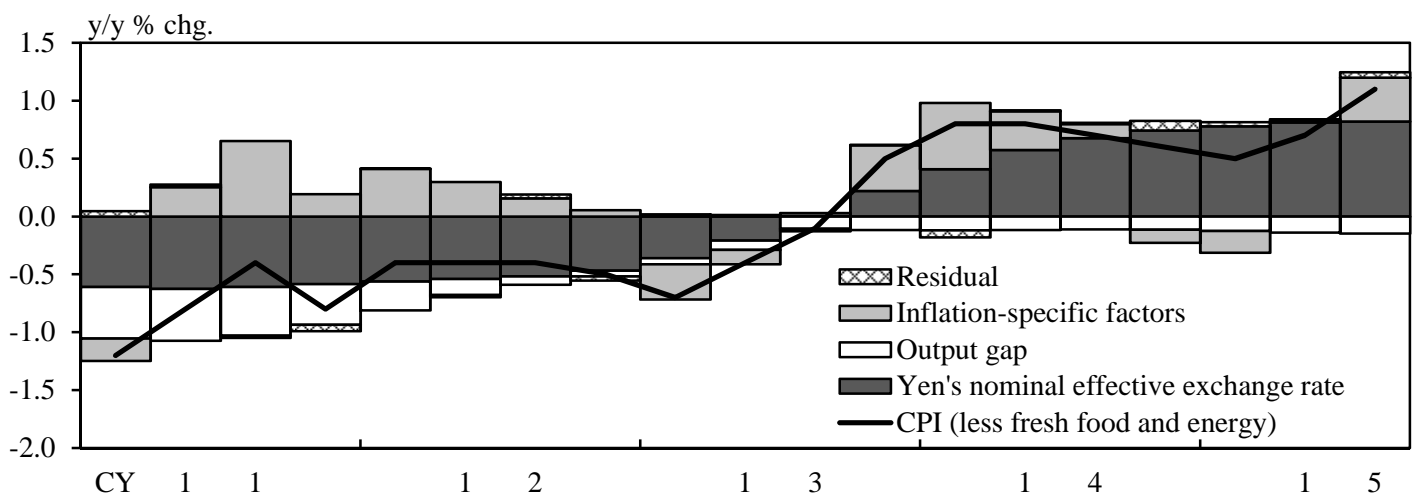
Effects of Exchange Rates on the CPI (1)

(1) Breakdown of Changes in the CPI (Less Fresh Food and Energy)

y/y % chg.

Others
Import-competing goods [1]
CPI (less fresh food and energy)

Import-competing goods	Weight (per 10,000)
Food (less fresh food and meals outside the home)	1,596
Electronic goods and furniture	338
Daily necessaries and clothes	489
Others	22
Total	2,445

CY 1 1 1 2 1 3 1 4 1 5

(2) Single Equation Approach[2]

y/y % chg.

Residual
Variables related to inflation expectations
Output gap
Yen's nominal effective exchange rate
CPI (less fresh food and energy)

CY 1 1 1 2 1 3 1 4 1 5

(3) VAR Model Approach[3]

y/y % chg.

Residual
Inflation-specific factors
Output gap
Yen's nominal effective exchange rate
CPI (less fresh food and energy)

CY 1 1 1 2 1 3 1 4 1 5

Notes: 1. Goods categories whose import share or pass-through rate of input prices is above 20%.

2. Figures are calculated using the estimation results shown in Box Chart 7 (1). The variables related to inflation expectations consist of inflation expectations, lag of the dependent variable, and a constant.

3. Figures are calculated using the VAR model estimated in Box Chart 7 (2).

4. Figures for the CPI (less fresh food and energy) are calculated by the Research and Statistics Department, Bank of Japan.

5. Figures for the CPI are adjusted to exclude the estimated effects of changes in the consumption tax rate.

Sources: Ministry of Internal Affairs and Communications; Cabinet Office; BIS; Consensus Economics Inc., "Consensus Forecasts," etc.

Effects of Exchange Rates on the CPI (2)

(1) Single Equation Approach[1]

< Estimation Equation >

CPI (less fresh food and energy)
(y/y % chg.)
= c (constant)
+ α × output gap (2-quarter lag, %)
+ β × medium- to long-term inflation expectations
(6 to 10 years ahead, %)
+ (1-β) × lag of the dependent variable
(4-quarter average, %)
+ (γ) ×(-1) yen's nominal effective exchange rate
(q/q, Almon lag, %)

< Estimation Results >

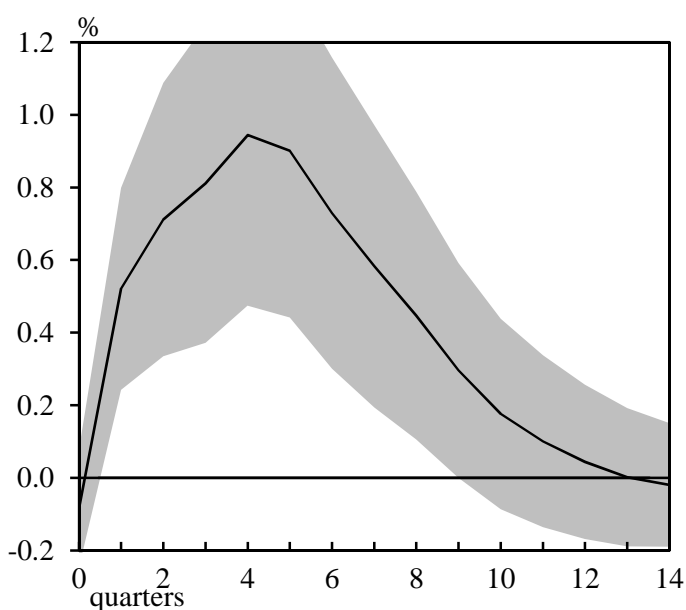|	CPI (less fresh food and energy)	
c	-0.31 ***	-0.37 ***
α	0.07 ***	0.11 ***
β	0.32 ***	0.37 ***
1-β	0.68 ***	0.63 ***
γ	0.10 ***	-
Adj. R^2	0.90	0.87
S.E.	0.31	0.36

The estimation period is 1991/Q1 - 2015/Q3.
*** denotes statistical significance at the 1% level.

(2) VAR Model Approach[2]

(Estimation Model: Trivariate VAR)
Shock identification is based on Cholesky decomposition in the following order.
< 1. Yen's nominal effective exchange rate, 2. Output gap, 3. CPI (less fresh food and energy) >
The estimation period is 1991/Q1 - 2015/Q3.

Responses to a 10-percent yen depreciation shock
(a) Output Gap

(b) CPI (Less Fresh Food and Energy)

VAR model approach
Single equation approach
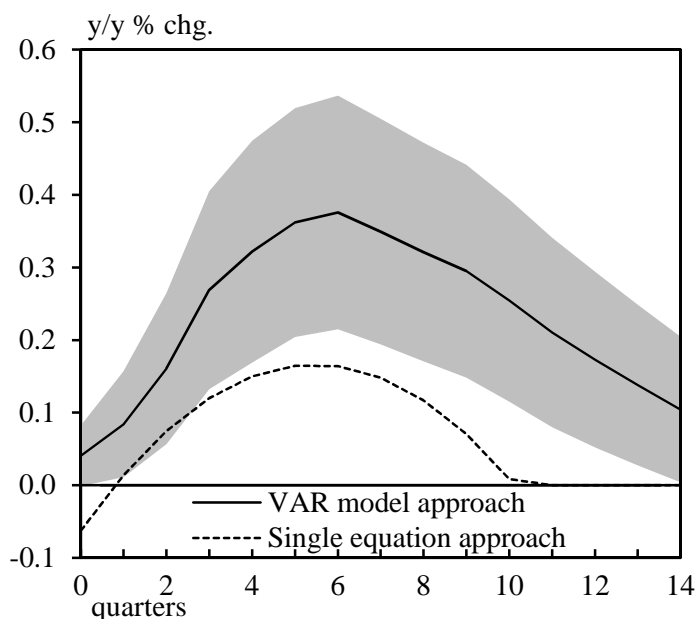
Notes: 1. The maximum lag length for the yen's nominal effective exchange rate is 10 quarters. The parameter γ is the sum of
parameters estimated for lags from 0 to 10 quarters.
2. Except for the output gap, variables in the estimation are quarter-on-quarter changes.
Shaded areas indicate 75% percentile bands.
3. Figures for the CPI (less fresh food and energy) are calculated by the Research and Statistics Department, Bank of Japan.
4. Figures for the CPI are adjusted to exclude the estimated effects of changes in the consumption tax rate.
Sources: Ministry of Internal Affairs and Communications; Cabinet Office; BIS;
Consensus Economics Inc., "Consensus Forecasts," etc.