INTERNATIONAL NEWS AND RELATIONSHIP BETWEEN EXCHANGE RATE OF YEN, TOPIX INDEX AND SECTORAL STOCK INDICES

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Research objective

In this paper, we examine how news about the results of important international economic and political events such as the Brexit referendum and the United States presidential election affected returns, volatility and co-movements of the exchange rate of yen, TOPIX index and sectoral stock indices in Japan.
Sectoral stock indices

The sectoral stock indices include the TOPIX components with the weight of five percent and more, namely, transportation equipment index, electric appliances index, banks index, information and communication index, chemicals index and machinery index.
Table 1. Daily logarithmic returns of the exchange rates and stock price indices.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>ADF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Period: 9 February 2016 to 24 March 2017</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JPY</td>
<td>−0.00019</td>
<td>0.00840</td>
<td>−0.54315</td>
<td>8.59034</td>
<td>−3.633 ***</td>
</tr>
<tr>
<td>TOPIX</td>
<td>0.00041</td>
<td>0.01458</td>
<td>−0.36411</td>
<td>9.87909</td>
<td>−5.303 ***</td>
</tr>
<tr>
<td><strong>Sectoral stock indices</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation equipment</td>
<td>0.00038</td>
<td>0.01877</td>
<td>-0.24959</td>
<td>6.89850</td>
<td>−4.746 ***</td>
</tr>
<tr>
<td>Electric appliances</td>
<td>0.00115</td>
<td>0.01618</td>
<td>-0.34154</td>
<td>8.93974</td>
<td>−5.797 ***</td>
</tr>
<tr>
<td>Banks</td>
<td>0.00099</td>
<td>0.02211</td>
<td>0.35566</td>
<td>5.18242</td>
<td>−4.564 ***</td>
</tr>
<tr>
<td>Information and communication</td>
<td>0.00046</td>
<td>0.01381</td>
<td>−0.45018</td>
<td>8.46889</td>
<td>−4.609 ***</td>
</tr>
<tr>
<td>Chemicals</td>
<td>0.00102</td>
<td>0.01469</td>
<td>0.01984</td>
<td>10.0903</td>
<td>−5.122 ***</td>
</tr>
<tr>
<td>Machinery</td>
<td>0.00124</td>
<td>0.01685</td>
<td>0.17977</td>
<td>8.55586</td>
<td>−5.100 ***</td>
</tr>
</tbody>
</table>

Note: The maximum number of lags for the augmented Dickey–Fuller (ADF) test selected by the Schwarz–Bayesian information criterion (SBIC) was 15. For the ADF test, ***, ** and * indicate values less than the critical value at 1%, 5%, and 10% significance levels. Obs.: 276.
Data

Figure 1. Levels and returns for the exchange rate of yen and TOPIX index.

Note: The vertical reference lines indicate the days in which the Brexit referendum (BR) and the United States presidential election (USE) took place.
Data

Figure 2. Levels and returns for the sectoral stock indices.

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EGARCH Model

The conditional mean equation

\[ r_t = C + \sum_{i=1}^{k} a_i r_{t-i} + \varepsilon_t. \]  \hspace{1cm} (1)

The variance equation

\[ \ln(\sigma_t^2) = \omega + \sum_{i=1}^{p} (\gamma_i \varepsilon_{t-i}/\sigma_{t-i} + \alpha_i (|\varepsilon_{t-i}/\sigma_{t-i}| - (2/\pi)^{1/2})) + \sum_{i=1}^{q} \beta_i \ln(\sigma_{t-i}^2). \]  \hspace{1cm} (2)

In Equation (1), the returns \( r \) at time \( t \) are the function of a constant \( C \), previous returns, and information \( \varepsilon \) available at time \( t \). In Equation (2), the variance \( \sigma^2 \) at time \( t \) is the function of a constant \( \omega \), past variance, and past news about volatility. Parameter \( a \) in Equation (1) is the coefficient for the impacts of previous returns. Parameters \( \gamma, \alpha, \text{and } \beta \) in Equation (2) are the coefficients for the asymmetric impacts of past news, symmetric impacts of past news, and impacts of past variance, respectively. A negative sign for these parameters is not precluded. Dummy variables for the first week after the BR and USE and for the first and second weeks combined after the BR and USE are incorporated as additional independent variables in the conditional mean and variance equations. Parameters \( k, p \) and \( q \) in Equations (1) and (2) are specified based on the Schwarz–Bayesian information criterion (SBIC) and the log-likelihood ratio. The Ljung–Box \( Q \) test is used to evaluate the robustness of the model specification.
Cross-correlation function

The sample cross-correlation coefficient $\hat{\rho}_{uv}(j)$ at lag $j$

$$\hat{\rho}_{uv}(j) = \frac{c_{uv}(j)(c_{uu}(0)c_{vv}(0))^{-1/2}}{1}$$

$c_{uv}(j)$ is the $j$-th lag sample cross covariance and $c_{uu}(0)$ and $c_{vv}(0)$ are the sample variances of $u$ and $v$. Here, $u$ and $v$ are the standardized residuals derived from Equations (1) and (2) for the exchange rate and stock price index. Standardized residuals are used when estimating causality in mean, and squared standardized residuals are used instead of standardized residuals when estimating causality in variance.
The null hypothesis of “no causality”

Hong’s (2001) $Q$-statistic

$$Q = \left\{ T \sum_{j=1}^{T-1} k^2(j/M) \hat{\rho}_{uv}(j) - C_{1T}(k) \right\}/\left\{ 2D_{1T}(k) \right\}^{1/2}, \quad \text{(4)}$$

where

$$C_{1T}(k) = \sum_{j=1}^{T-1} (1 - j/T)k^2(j/M) \quad \text{(5)}$$

and

$$D_{1T}(k) = \sum_{j=1}^{T-1} (1 - j/T)(1 - (j + 1)/T)k^4(j/M). \quad \text{(6)}$$

The computed $Q$-statistics were compared to the upper-tailed critical value of $N(0;1)$ at an appropriate level. A $Q$-statistics value larger than the critical value means the null hypothesis of “no causality” is rejected.
Estimation results

• The BR and USE caused changes in levels and returns of exchange rate of yen and stock prices indices.
• The empirical findings showed that exchange rate of yen and TOPIX index returns were significantly affected by the BR and USE within two weeks of the events.
• The BR caused exchange rate of yen to appreciate and the TOPIX index to decrease.
• The BR increased the volatility of exchange rate in the first week, causing instability in Japanese financial markets.
• The BR and USE affected the causality relationship between the exchange rate and stock price indexes.
• A casualty in mean was found from exchange rate to information and communication index, chemicals index and machinery index.
• A casualty in mean was found from TOPIX index to banks index, information and communication index, and chemicals index.
• A casualty in variance was found from exchange rate and TOPIX index to all sectoral indices.
• The BR and USE may affect the sectoral indices also indirectly, through exchange rate and TOPIX index.