



CROSS-TIME-FREQUENCY ANALYSIS OF VOLATILITY INTERDEPENDENCE AMONG STOCK AND CURRENCY MARKETS

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ABSTRACT

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Volatility transmission between stock markets and currency markets is an ongoing debate in the pertinent literature. However, the majority of the previous studies have used only daily data with a limited sample. This study aims to fill this gap by identifying how sample stock markets and currencies play the role of volatility transmitter and receiver, particularly on an intraday basis. To this end, this research detects volatility interdependencies among various stock markets and currencies using five major stock indices and six major currency pairs. The results for daily and intraday frequencies are quite disparate. In particular, the results signify that the transmission of volatility from currency markets to stock markets is much stronger on an intraday basis. The results also indicate a strengthening of the volatility transmission and spillover interdependence among stock markets on a daily basis. These results may be ascribed to the continuous trading mechanism of these markets, which in turn allows the news to impact these markets first, which then transmit it to stock markets. The findings obtained also imply that intraday price fluctuations in major currencies should be closely tracked to monitor intraday volatility patterns in stock markets.

Contribution/Originality: This study is one of very few studies which have investigated volatility interdependencies among various stock markets and currencies by utilising daily and intraday data simultaneously. The findings are also unique signifying that the transmission of volatility from currency markets to stock markets is much stronger on an intraday basis.

1. INTRODUCTION

The pattern of volatility spillover in global financial markets is one of the most critical issues for traders and policymakers because a strong volatility interaction between various markets has advantages and disadvantages. While the existence of volatility spillover in currency markets may limit hedging opportunities, it may also allow for possible speculative trading gains. Volatility spillover is associated with information flow (Ross, 1989), so volatility spillover studies improve the understanding of information transmission within or across different markets. Cross-market volatility spillover studies are important for gauging the speed of different financial markets' adjustment to new information. Volatility transmission between stock markets and currency markets is an ongoing debate in the pertinent literature. The volatility interdependence between these two markets is of critical importance for portfolio managers and speculators. Most studies of volatility transmission in these two markets have documented the informational impact of stock markets on currency markets through volatility spillover

(Andreou, Matsi, & Savvides, 2013; Caporale, Hunter, & Ali, 2014; Do, Brooks, Treepongkaruna, & Wu, 2016; Mitra, 2017; Sui & Sun, 2016). In terms of volatility transmission between exchange rates and stock prices, Kanas (2000); Yang and Doong (2004); Adjasi, Harvey, and Agyapong (2008); Yang and Chang (2008); Fedorova and Saleem (2009); O'Donnell and Morales (2009); Antonakakis (2012); Beer and Hebein (2011); Kang and Yoon (2013) and Chkili and Nguyen (2014) have found unidirectional transmission of volatility between equity and currency markets. Despite the empirical evidence provided in the literature mentioned above, other studies have reported no evidence of the flow of volatility between stock markets and foreign exchange markets (Apergis & Reztis, 2001; Kearney & Daly, 1998; Morales, 2008). However, almost all the aforementioned studies have used only daily data from a limited sample despite the significance of intraday data in capturing volatility transmissions, as documented in various studies (Andersen & Bollerslev, 1997; Andersen, Bollerslev, & Cai, 2000; Füss, Mager, Stein, & Zhao, 2018; Kitamura, 2010; Luo & Ji, 2018; Melvin & Melvin, 2003; Phan, Sharma, & Narayan, 2016).

This study aims to fill this gap by examining the volatility transmission patterns between major stock markets and currency pairs using the VAR-BEKK-GARCH model and both intraday and daily data. In particular, it aims to identify how sample stock markets and currencies play the role of volatility transmitter and receiver, particularly on an intraday basis. This will enable us to identify whether volatility transmission to major stock markets stems from other major stock markets or from major currency markets, which in turn will help determine the relative informational impact of major stock and currency markets. Using intraday data will help us better assess their informational interdependence. As discussed above, earlier studies have not examined volatility interdependence between stock and currency markets using a comparative approach that includes both daily and intraday observations. This study uses one of the most extensive samples in the relevant literature, consisting of eleven financial instruments (five stock market indices and six currency pairs). Furthermore, the sample period spans from January 2012 to December 2019, constituting one of the largest observation sets, particularly for intraday data.

The results of this study are therefore expected to have vital implications for both academicians and practitioners, and they are likely to be generalizable for determining the volatility linkage between stock and currency markets from a micro-market perspective.

2. DATA & METHODOLOGY

The dataset for this study consists of five major stock indices and six most traded currency pairs: CAC40, DAX30, NIKKEI225, FTSE100, DJI30, Euro (EURUSD), British Pound (GBPUSD), Japanese Yen (USDJPY), Swiss Franc (USDCHF), Australian Dollar (AUDUSD), and Canadian Dollar (USDCAD). The rationale for not extending the sample is the fact that these indices and currency pairs held the highest trading volume globally¹.

The data includes trading quotes obtained from Reuters, crosschecked with quotes from Bloomberg to confirm their accuracy. The sample period spans from January 1, 2012 to December 31, 2019 and consists of daily observations and observations at 30-minute intervals. The primary reason for selecting this sample period is data availability. The 30-minute interval observations alone yield 55767 data points, which is a sufficient number to conduct the required analyses. Furthermore, the price quotations are gathered from real-time transaction data to ensure they are representative of actual trading data.

This study uses the VAR-BEKK-GARCH model, a multivariate volatility specification model proposed by Engle and Kroner (1995) to measure the dynamics of the conditional volatility and volatility interdependence among sample currencies. The full BEKK model has three main advantages over VECH-GARCH and other alternative specifications of the MGARCH models: First, the VAR-BEKK-GARCH model allows for cross-sectional

¹In the study currency sample consists of major currencies only. Even so, according to 2019 Bank for International Settlement (BIS) survey there is a 39% difference between the least traded currency within the study's sample (Swiss Franc) and next highest traded currency (Hong Kong Dollar) which is left out from the sample.

dynamics. More specifically, VAR-BEKK-GARCH not only defines volatility spillover but also indicates the detailed directions within revealed spillovers, which fits best to our research objective.

In this respect, other widely used specifications, including VECH-GARCH or DCC-GARCH, do not serve our purposes since both models reveal information only about the magnitude and not the direction of volatility interdependencies. Secondly, by construction, VAR-BEKK-GARCH model guarantees a positive estimated variance-covariance matrix. Finally, VAR-BEKK-GARCH is more parsimonious, allowing the reduction of the number of estimated parameters by enforcing restrictions both within and across equations.

The VAR-BEKK-GARCH model is conducted using the quasi-maximum likelihood estimation procedure.

$$\log L = -\frac{1}{2} \sum_{t=1}^T [k \log(2\pi) + \ln |H_t| + \varepsilon_t' H_t^{-1} \varepsilon_t] \tag{1}$$

Equation 1 above represents the log-likelihood function for a given sample of T observations. In Equation 1 L is the parameter vector to be estimated, k is the number of the variables, T is a sample of organizations and H_t is the conditional variance-covariance matrix, and ε_t is assumed to follow a joint Gaussian log-likelihood function.

The unrestricted model used in analyses is presented in Equation 2 through Equation 5 below:

$$H_t = C_0' C_0 + \begin{bmatrix} a_{ii} & a_{ij} \\ a_{ji} & a_{jj} \end{bmatrix} \begin{bmatrix} \varepsilon_{i,t-1}^2 & \varepsilon_{i,t-1} \varepsilon_{j,t-1} \\ \varepsilon_{i,t-1} \varepsilon_{j,t-1} & \varepsilon_{j,t-1}^2 \end{bmatrix} + \begin{bmatrix} b_{ii} & b_{ij} \\ b_{ji} & b_{jj} \end{bmatrix} H_{t-1} \begin{bmatrix} b_{ii} & b_{ji} \\ b_{ji} & b_{jj} \end{bmatrix} \tag{2}$$

$$h_{ii,t} = c_{ii}^2 + a_{ii}^2 \varepsilon_{i,t-1}^2 + 2a_{ii} a_{ij} \varepsilon_{i,t-1} \varepsilon_{j,t-1} + a_{ji}^2 \varepsilon_{j,t-1}^2 + b_{ii}^2 h_{ii,t-1} + 2b_{ii} b_{ij} h_{ij,t-1} + b_{ji}^2 h_{jj,t-1} \tag{3}$$

$$h_{jj,t} = c_{jj}^2 + c_{ij}^2 + a_{ij}^2 \varepsilon_{i,t-1}^2 + 2a_{ij} a_{jj} \varepsilon_{i,t-1} \varepsilon_{j,t-1} + a_{jj}^2 \varepsilon_{j,t-1}^2 + b_{ij}^2 h_{ii,t-1} + 2b_{ij} b_{jj} h_{ij,t-1} + b_{jj}^2 h_{jj,t-1} \tag{4}$$

$$h_{ij,t} = c_{ii} c_{jj} + a_{ii} a_{ij} \varepsilon_{i,t-1}^2 + (a_{ji} a_{ij} + a_{ii} a_{jj}) \varepsilon_{i,t-1} \varepsilon_{j,t-1} + a_{ji} a_{jj} \varepsilon_{j,t-1}^2 + b_{ii} b_{ij} h_{ii,t-1} + (b_{ji} b_{ij} + b_{ii} b_{jj}) h_{ij,t-1} + b_{ji} b_{jj} h_{jj,t-1} \tag{5}$$

Equation 2 is used to determine the bilateral impacts among indices, whereas Equation 3 is used to measure cross-currency-index impacts. Equation 4 expresses the conditional covariances ($h_{ij,t}$) derived from Equation 2 and Equation 3.

In Equation 3, the parameters a_{ij} and a_{ji} capture the bi-directional shock transmission effects while b_{ij} and b_{ji} capture the volatility spillover effects among the selected stock indices and currencies.

3. EMPIRICAL RESULTS

The estimation results from the VAR-BEKK-GARCH model for daily and 30-minute observations are reported in Tables A-1 and A-2 in the Appendix. Tables 1 and 2 reports the summarized results for volatility spillover effects at daily and intraday frequencies. The arrows indicate the direction of the interdependencies, if any, between the sample indices and currencies. Further analysis of the results, including the coefficients and statistical significance of short-term shocks and volatility transmissions, is provided in the Appendix. Before moving to the interpretation of the findings, it is noted that the estimation output provides robust coefficients. To elaborate, the statistical significance and persistence parameters of individual coefficients, as well as the model, validate the estimation quality.

Table-1. Daily VAR-BEKK-GARCH Summary.

Currency	CAC40	DAX30	NIKKEI225	FTSE100	DOW30	AUDUSD	EURUSD	GBPUSD	USDCAD	USDCHF	USDJPY	Total
<i>Volatility Transmission</i>												
CAC40	-----	↔	↔	←	←	→	↔	→	↔	↔	↔	
DAX30	↔	-----	→	↔	←	→	↔	↔	→	↔	→	Unilateral | 27
NIKKEI225	↔	←	-----	←	←	→	→	→	↔	↔	↔	Bilateral | 21
FTSE100	→	↔	→	-----	→	-	←	↔	↔	↔	↔	None | 2
DOW30	→	→	→	←	-----	→	-	→	→	↔	→	

Notes: ↔ indicates a bidirectional volatility transmission, → or ← indicates a unilateral volatility transmission, and - indicates no volatility transmission. ← means the related pair on the first column is volatility receiver while → is the indication of volatility transmitter.

Table-2. 30 Minute VAR-BEKK-GARCH Summary.

Currency	CAC40	DAX30	NIKKEI225	FTSE100	DOW30	AUDUSD	EURUSD	GBPUSD	USDCAD	USDCHF	USDJPY	Total
<i>Volatility Transmission</i>												
CAC40	-----	→	←	→	↔	↔	↔	←	→	→	↔	
DAX30	←	-----	↔	←	↔	↔	←	←	→	↔	↔	Unilateral | 18
NIKKEI225	→	↔	-----	↔	↔	↔	←	↔	↔	↔	↔	Bilateral | 32
FTSE100	←	→	↔	-----	↔	→	↔	↔	↔	↔	↔	None | 0
DOW30	↔	↔	↔	↔	-----	↔	←	↔	↔	→	↔	

Notes: ↔ indicates a bidirectional volatility transmission, → or ← indicates a unilateral volatility transmission, and - indicates no volatility transmission. ← means the related pair on the first column is volatility receiver while → is the indication of volatility transmitter.

The results of volatility spillover analyses may be interpreted as follows:

The number of significant volatility transmissions between indices as well as between indices and currencies (a total of 50 unilateral and bilateral transmissions) in the intraday analysis are higher compared to daily (a total of 48 unilateral and bilateral transmissions).

The number of bilateral volatility interdependencies is much higher in the intraday analysis as well (32 versus 21). These results clearly denote that volatility transmission throughout the day resulting possibly from rapid information dissemination between stock and currency markets as well as among stock markets are much frequent and stronger.

The number of volatility interdependencies, as well as the volatility transmitter and receiver roles, in the daily and intraday analyses, are quite distinctive. In particular, in the daily results, we observe a total of 14 significant volatility interdependencies between sample stock indices and 13 interdependencies between indices and currencies. Conversely, in the intraday results, we observe a total of 6 interdependencies among indices and 10 between indices and currencies.

These results signify that, although lower in number, intraday volatility interdependencies among stock markets are mostly bilateral. Daily volatility interdependency results, on the other hand, indicate a higher number of unilateral volatility transmissions. In particular, Dow Jones and FTSE are the two major indices transmitting volatility to the other three indices. These results are consistent with various studies (Al Rahahleh & Bhatti, 2017; Jawadi, Louhichi, & Idi Cheffou, 2015; Santamaria, Gomez-Gonzalez, Hurtado-Guarin, & Melo-Velandia, 2017). On the other hand, in daily analyses, NIKKEI and CAC40 seem to be the most distinguished net volatility receivers². Specifically, there are a total of 5 volatility spillovers to these two indices from the remaining three indices. On the other hand, these two indices do not act as net volatility transmitter to any.

The cross-market volatility interdependency results are even more remarkable, signifying that the frequency of volatility transmission from currencies to indices is higher in intraday transactions than on a daily basis (5 compared to 1). Conversely, the frequency of volatility transmission from indices to currencies is higher in daily transactions (12 compared to 5). These findings may be ascribed to the relatively high volatility level of stock markets. The VIX index, which is regarded as the best proxy to assess the overall sentiment of financial markets, has the highest fluctuation among all comparable indices. A strong volatility impact from indices on currencies is therefore expected.

The results from the daily observations reveal a noteworthy volatility transmission among stock indices. Furthermore, most indices play the role of volatility transmitter for the sample currencies.

The results from the intraday analyses contrast with the daily results. Specifically, in intraday volatility patterns, indices receive volatility from currencies, particularly from the Euro and British Pound. The volatility transmitter role of the Euro and Pound has been documented in previous studies (Antonakakis, 2012; Kitamura, 2010; McMillan & Speight, 2010).

These results are novel yet unsurprising. One unambiguous distinction between currency and stock markets is that trading in the former markets is continuous, whereas it is session-based in the latter. In this respect, particularly during the off-trading hours of stock markets, the news first affects currency markets, which may create initial volatility that is then transmitted to stock markets.

These results have vital implications for international traders and portfolio managers. The results denote that, to conduct a dynamic and effective hedging strategy in stock portfolios, portfolio managers should diligently observe the price oscillations in major currencies, as these oscillations are contagious to other major stock markets.

² A financial asset is considered as net volatility transmitter if it transmits more to other assets than it receives from them unilaterally. Likewise, it is considered as net volatility receiver if it receives more volatility from other than it transmits unilaterally.

Similarly, the results imply that currency traders should carefully monitor fluctuations in stock markets, as these fluctuations spread to major currencies over a longer window of time.

As discussed earlier, this study is one of few studies to use both intraday and daily data. In this regard, dissimilarities in the volatility transmission patterns of the two sampling frequencies denote the indisputable significance of intraday data for volatility linkage analyses in international financial markets.

4. CONCLUSION

The cross-market volatility spillover mechanism in financial instruments and markets is a subject of ongoing debate in finance literature. The volatility spillover between stock and currency markets, the two largest financial markets, is frequently discussed in the pertinent literature. Yet, the literature still lacks a comprehensive comparative study that examines these relationships using daily and intraday observations for the same markets. This approach is highly important because the trading sessions and mechanisms are unique in these markets.

Accordingly, this study uses both daily and intraday observations to detect volatility interdependence between stock and currency markets as well as among stock markets.

Analysis of an extensive number of daily and intraday observations revealed interesting results. The role of each individual market changes dramatically between daily and intraday observations of volatility spillover mechanisms. In particular, as demonstrated by various other studies, major stock markets transmit volatility to most currency pairs as well as to other stock markets when observed on a daily basis. This result may best be explained by the higher level of trading and volatility accumulated in these markets. However, in intraday trading, major currency pairs transmit volatility to stock markets. This result may be ascribed to the continuous trading mechanism of these markets, which in turn allows the news to impact these markets first, which then transmit it to stock markets.

Furthermore, the results signify that bilateral volatility spillover between stock and currency markets is much higher in intraday trading than in daily trading. This result highlights the importance of using intraday observations to better capture the volatility interdependencies between these markets.

This study might pave the way for similar studies aiming to further examine the impact of volatility interdependence between these two markets. A larger sample that includes some minor currencies and stock indices of emerging markets could be utilized to obtain more robust results.

Furthermore, one inherent assumption utilized in this study was that intraday volatility in higher frequencies incorporates news announcements as revealed in recent studies (Chan & Gray, 2018; Kenourgios, Papadamou, & Dimitriou, 2015). Yet, even beyond the scope of this particular study, the impact of news announcements can be examined in further studies by including news innovation in GARCH specifications, which requires rummaging all available news announcements to impact all sample currency pairs simultaneously, in an intraday setting.

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APPENDIX

Table-A.1. Daily VAR-BEKK-GARCH Results.

AUDUSD	EURUSD	GBPUSD	CAC40	USDCAD	USDCHF	DAX30	USDJPY	NIKKEI225	FTSE100	DOW30
$ar(1)_{11}$	0.001 [0.030]	-0.030 [-1.180]	-0.003 [-0.086]	***- 0.046 [-1.812]	-0.020 [-0.967]	*-0.066 [-3.336]	-0.028 [-1.281]	**0.050 [2.124]	-0.016 [-0.705]	-0.009 [-0.376]
$ar(1)_{li}$	** -0.064 [-2.331]	-0.048 [-1.342]	-0.041 [-1.310]	-0.028 [-0.777]	***0.034 [1.792]	***0.846 [1.762]	0.008 [0.339]	*0.095 [4.778]	**0.051 [2.182]	0.024 [1.077]
Constant	0.000 [-0.457]	0.000 [-0.720]	0.000 [-0.799]	0.000 [-0.771]	0.000 [-0.473]	0.000 [-0.983]	0.000 [0.056]	*-0.001 [-3.777]	0.000 [-0.956]	0.000 [-0.467]
$ar(1)_{il}$	*-0.049 [-2.714]	***- 0.027 [-1.698]	-0.008 [-0.222]	0.011 [0.596]	0.036 [1.557]	*-0.001 [-3.808]	0.015 [0.939]	*-0.138 [-6.063]	** -0.055 [-2.179]	** -0.060 [-2.370]
$ar(1)_{ii}$	0.035 [1.517]	0.034 [1.523]	-0.022 [-0.648]	-0.042 [-1.642]	-0.006 [-0.227]	*-0.068 [-3.262]	0.002 [0.102]	*-0.227 [-7.182]	*-0.082 [-3.301]	*-0.085 [-3.557]
Constant	***0.000 [-1.738]	0.000 [-0.344]	0.000 [-0.174]	0.000 [1.039]	***0.000 [-1.923]	0.000 [0.180]	0.000 [1.014]	*0.001 [10.529]	0.000 [1.352]	0.000 [1.469]
c_{11}	*-0.001 [-6.924]	*-0.001 [-4.267]	*0.001 [7.621]	*0.001 [6.020]	*-0.001 [-5.368]	*0.001 [14.797]	*0.001 [25.041]	0.000 [0.754]	*-0.002 [-10.225]	*-0.001 [-5.651]
c_{i1}	0.000 [0.846]	0.000 [0.382]	*0.001 [9.330]	**0.000 [-2.570]	*-0.002 [-139.354]	*0.000 [-3.703]	***0.000 [-1.699]	0.001 [0.636]	*-0.003 [-12.860]	0.000 [-1.110]

c_{ii}	*0.000 [4.120]	0.000 [0.000]	*0.000 [-22.347]	**0.000 [-2.021]	0.000 [0.000]	*0.000 [21.831]	0.000 [0.000]	*0.005 [5.017]	0.000 [0.000]	0.000 [1.255]
α_{11}	*0.266 [12.470]	*0.251 [12.428]	*0.183 [11.853]	*0.184 [6.024]	*0.263 [15.842]	*0.194 [62.278]	*0.258 [68.056]	*0.136 [6.765]	0.053 [1.385]	*0.252 [10.434]
α_{1i}	0.019 [1.235]	*0.105 [6.266]	*0.299 [19.018]	-0.008 [-0.468]	0.007 [0.455]	0.000 [-0.557]	*0.051 [18.317]	*-0.132 [-3.441]	*-0.260 [-8.613]	***- 0.043 [-1.823]
α_{i1}	**0.069 [-2.139]	*-0.280 [-8.340]	*0.061 [10.534]	-0.067 [-1.562]	*0.055 [4.812]	*-1.285 [-9.284]	*0.039 [7.081]	0.025 [0.514]	-0.026 [-0.838]	0.029 [0.950]
α_{ii}	*0.178 [10.439]	*0.082 [2.947]	*-0.077 [-11.754]	*0.196 [8.949]	*0.187 [25.496]	*0.520 [130.068]	*0.205 [86.243]	*0.930 [15.501]	*0.141 [4.462]	*0.151 [7.413]
β_{11}	*0.956 [136.267]	*0.918 [119.453]	*0.820 [111.445]	*0.970 [120.733]	*0.954 [157.667]	*0.978 [1795.372]	*0.960 [1331.092]	*0.919 [36.730]	*0.803 [39.625]	*0.959 [116.980]
β_{1i}	-0.004 [-0.874]	*-0.057 [-6.469]	*1.629 [259.837]	***0.008 [1.677]	**0.009 [-2.365]	***0.000 [1.911]	*-0.019 [-40.831]	*-0.408 [-8.842]	*-0.154 [-10.481]	0.007 [1.011]
β_{i1}	**0.023 [2.326]	*0.134 [9.772]	*0.165 [22.491]	-0.002 [-0.150]	*-0.032 [-6.194]	*0.285 [6.866]	*0.003 [2.889]	**0.105 [-2.380]	*-0.220 [-10.731]	-0.014 [-1.521]
β_{ii}	*0.983 [243.825]	*1.019 [145.241]	*-0.841 [-122.822]	*0.986 [171.881]	*0.959 [2444.216]	*0.902 [823.343]	*0.977 [2580.710]	*0.197 [3.606]	*0.763 [34.976]	*0.986 [172.893]

Table-A.1. Daily VAR-BEKK-GARCH Results (Contd.).

EURUS D	GBPUS D	CAC40	USDCA D	USDCH F	DAX30	USDJPY	NIKKEI22 5	FTSE10 0	DOW3 0
$ar(1)_{11}$	0.016 [0.786]	0.031 [1.280]	0.019 [0.863]	0.016 [0.582]	-0.027 [-1.245]	0.000 [0.006]	-0.003 [-0.139]	0.034 [1.197]	***0.05 5 [1.723]
$ar(1)_{1i}$	-0.016 [-0.609]	**0.045 [-2.478]	**0.046 [2.032]	0.015 [0.704]	0.414 [0.851]	-0.005 [-0.252]	*0.065 [4.191]	0.037 [1.618]	**0.049 [1.964]
Constant	0.000 [-0.927]	0.000 [-0.527]	0.000 [-1.382]	0.000 [-0.882]	0.000 [-0.629]	0.000 [-1.293]	0.000 [-0.731]	***0.000 [-1.940]	0.000 [-0.939]
$ar(1)_{i1}$	0.010 [0.516]	-0.005 [-0.147]	**0.040 [2.126]	-0.045 [-1.112]	**0.001 [-2.291]	0.029 [1.550]	*-0.103 [-3.510]	***0.066 [-1.697]	*-0.113 [-2.760]
$ar(1)_{ii}$	0.021 [1.014]	-0.033 [-1.315]	-0.024 [-1.045]	-0.049 [-1.279]	*-0.060 [-2.821]	0.017 [0.724]	*-0.127 [-4.256]	***0.055 [-1.699]	*-0.110 [-3.592]
Constant	0.000 [0.147]	0.000 [0.520]	0.000 [1.063]	0.000 [-0.231]	0.000 [-0.617]	0.000 [1.298]	*0.001 [5.355]	0.000 [1.378]	0.000 [0.691]
c_{11}	*0.000 [-6.981]	0.000 [-0.292]	**0.000 [2.331]	*0.000 [4.448]	*0.000 [17.793]	*0.000 [4.452]	0.000 [-1.556]	***0.000 [1.696]	*0.000 [4.446]
c_{i1}	***0.000 [-1.899]	*0.000 [18.513]	0.000 [-0.198]	**0.003 [-2.533]	0.000 [1.111]	0.000 [-0.366]	*-0.004 [-17.022]	0.000 [0.003]	0.000 [0.013]
c_{ii}	*0.000 [6.291]	*-0.001 [40.758]	*0.000 [-5.103]	0.002 [1.638]	*0.000 [19.796]	*0.001 [5.500]	0.000 [0.000]	*0.001 [6.386]	*-0.001 [6.202]
α_{11}	*0.217 [16.957]	*0.198 [16.481]	*0.154 [7.925]	*0.164 [6.955]	*0.173 [65.479]	*0.190 [24.861]	*0.153 [5.850]	*0.125 [3.979]	*0.192 [6.954]
α_{1i}	*0.051 [2.739]	*0.050 [3.083]	0.026 [1.218]	*0.142 [3.923]	*-0.001 [-4.863]	0.028 [1.534]	*0.779 [17.856]	*0.194 [4.628]	***0.07 8 [1.772]
α_{i1}	*-0.063 [-3.019]	**0.030 [2.426]	*-0.069 [-3.836]	-0.021 [-0.801]	*-0.473 [-3.772]	**0.034 [2.553]	**0.065 [-2.247]	**0.043 [-2.127]	0.002 [0.098]
α_{ii}	*0.168 [8.113]	*0.148 [9.421]	*0.224 [12.158]	*0.307 [7.950]	*0.534 [126.113]	*0.240 [10.228]	*1.031 [24.747]	*0.251 [10.768]	*0.236 [6.904]

β_{11}	*0.975 [-269.341]	*-0.414 [-36.426]	*0.986 [-250.022]	*1.001 [-83.725]	*0.984 [-2514.379]	*0.980 [-817.190]	*0.990 [-99.503]	*0.999 [-121.290]	*-0.982 [-128.726]
β_{li}	***-0.007 [-1.779]	*0.939 [-53.679]	-0.005 [-1.130]	*-0.130 [-5.331]	0.000 [-1.057]	-0.006 [-1.561]	*-0.346 [-10.024]	*-0.062 [-4.627]	*0.035 [-2.733]
β_{i1}	**0.012 [-2.150]	*0.845 [-91.197]	*0.013 [-2.769]	0.027 [-1.555]	**0.076 [-1.972]	**0.008 [-2.390]	0.021 [-1.074]	**0.014 [-2.190]	-0.002 [-0.240]
β_{ii}	*0.980 [-205.568]	*0.407 [-30.631]	*0.973 [-208.794]	*0.812 [-23.509]	*0.896 [-761.472]	*0.967 [-150.322]	*0.357 [-7.449]	*0.944 [-94.405]	*-0.956 [-90.357]

Table-A.1. Daily VAR-BEKK-GARCH Results (Contd.).

GBPU\$D	CAC40	USDCAD	USDCHF	DAX30	USDJPY	NIKKEI225	FTSE100	DOW30
$ar(1)_{11}$	0.021 [-0.874]	0.027 [-1.248]	-0.010 [-1.387]	0.008 [-0.353]	***0.039 [-1.817]	*0.060 [-5.973]	0.030 [-1.185]	0.006 [-0.246]
$ar(1)_{li}$	-0.013 [-0.918]	-0.012 [-0.589]	*0.014 [-2.904]	0.469 [-1.228]	0.021 [-1.212]	0.007 [-0.908]	0.010 [-0.625]	-0.005 [-0.303]
Constant	0.000 [-0.520]	0.000 [-0.102]	*0.000 [-9.214]	0.000 [-0.069]	0.000 [-0.555]	0.000 [-0.295]	0.000 [-0.418]	0.000 [-0.231]
$ar(1)_{i1}$	-0.050 [-1.412]	0.004 [-0.187]	***-0.029 [-1.792]	0.000 [-0.386]	0.019 [-0.843]	0.005 [-0.177]	**0.077 [-2.070]	-0.031 [-0.891]
$ar(1)_{ii}$	-0.014 [-0.596]	*-0.059 [-2.642]	-0.019 [-1.177]	*-0.058 [-2.706]	0.003 [-0.109]	*-0.076 [-3.639]	**0.051 [-2.034]	**0.058 [-2.437]
Constant	0.000 [-0.344]	0.000 [-1.019]	0.000 [-1.194]	0.000 [-0.407]	***0.000 [-1.803]	0.000 [-0.793]	0.000 [-1.187]	0.000 [-1.050]
c_{11}	0.000 [-0.002]	*0.000 [-2.679]	*0.001 [-27.072]	*0.000 [-13.571]	*0.000 [-4.826]	*0.000 [-33.812]	0.000 [-1.577]	0.000 [-0.859]
c_{i1}	*0.001 [-12.058]	*0.000 [-2.874]	*-0.001 [-22.533]	*0.000 [-8.206]	**0.001 [-2.192]	*-0.001 [-9.308]	*-0.001 [-5.056]	*-0.001 [-6.136]
c_{ii}	0.000 [-0.435]	0.000 [-0.437]	0.000 [-0.000]	*0.000 [-17.522]	0.000 [-0.643]	0.000 [-0.000]	0.000 [-0.000]	0.000 [-0.004]
α_{11}	*0.064 [-2.912]	*0.169 [-9.235]	*0.453 [-645.997]	*0.159 [-60.293]	*0.199 [-17.639]	*0.193 [-293.426]	*0.104 [-3.610]	*0.123 [-8.774]
α_{li}	*-0.299 [-9.664]	*0.058 [-3.079]	*-0.264 [-68.485]	0.000 [-0.131]	*-0.117 [-3.868]	*-0.157 [-87.208]	*0.223 [-6.629]	*0.205 [-8.250]
α_{i1}	*0.112 [-7.495]	*-0.089 [-5.678]	*0.048 [-34.329]	*-0.262 [-2.578]	0.014 [-0.880]	*-0.014 [-5.718]	*-0.078 [-5.801]	*-0.077 [-8.367]
α_{ii}	*0.238 [-14.540]	*0.216 [-15.786]	*0.098 [-23.615]	*0.535 [-123.501]	*0.255 [-6.758]	*0.077 [-13.201]	*0.165 [-8.556]	*0.191 [-11.277]
β_{11}	*1.010 [-169.995]	*-0.523 [-13.403]	*0.836 [-3456.602]	*0.985 [-2523.239]	*0.977 [-451.081]	*0.958 [-8526.788]	*0.997 [-118.868]	*1.003 [-317.712]
β_{li}	*0.114 [-6.109]	*-0.653 [-17.056]	*0.313 [-532.360]	**0.000 [-1.986]	*0.032 [-4.914]	*0.107 [-435.515]	*-0.092 [-7.905]	*-0.104 [-12.473]
β_{i1}	*-0.042 [-4.852]	*-1.033 [-48.574]	*-0.106 [-103.227]	0.015 [-0.500]	-0.006 [-1.071]	*-0.023 [-231.925]	*0.021 [-3.033]	*0.032 [-8.439]
β_{ii}	*0.929 [-115.887]	*0.526 [-15.703]	*1.030 [-1979.101]	*0.896 [-737.167]	*0.955 [-65.139]	*1.009 [-8177.601]	*0.947 [-139.083]	*0.941 [-220.924]

Table-A.1. Daily VAR-BEKK-GARCH Results (Contd.).

CAC40	USDCAD	USDCHF	DAX30	USDJPY	NIKKEI225	FTSE100	DOW30
$ar(1)_{11}$	-0.025 [-0.926]	-0.021 [-0.887]	**0.053 [-2.516]	-0.020 [-0.926]	0.011 [-0.555]	-0.025 [-0.982]	-0.014 [-0.555]
$ar(1)_{li}$	-0.025 [-0.620]	0.004 [-0.162]	0.469 [-0.900]	-0.002 [-0.069]	**0.051 [-2.494]	0.014 [-0.571]	0.004 [-0.142]
Constant	0.000 [-0.070]	0.000 [-0.246]	0.000 [-0.018]	0.000 [-0.271]	0.000 [-0.154]	0.000 [-0.449]	0.000 [-0.156]

$ar(1)_{il}$	-0.016 [-0.976]	0.019 [0.887]	*-0.001 [-3.326]	0.025 [1.522]	*0.040 [2.620]	-0.013 [-0.526]	-0.041 [-1.632]
$ar(1)_{ii}$	*-0.069 [-2.674]	-0.028 [-1.019]	*-0.072 [-2.848]	-0.003 [-0.121]	**0.051 [-2.286]	-0.036 [-1.446]	*-0.075 [-2.895]
<i>Constant</i>	0.000 [1.040]	**0.000 [-1.984]	0.000 [-0.620]	***0.000 [1.745]	*0.001 [6.289]	0.000 [1.138]	0.000 [1.035]
c_{11}	*-0.001 [-4.524]	*0.001 [3.335]	*0.001 [5.878]	0.000 [1.467]	0.000 [-0.034]	*-0.001 [-4.470]	*0.001 [4.067]
c_{il}	*0.000 [4.084]	0.001 [1.374]	0.000 [-1.088]	*-0.001 [-7.080]	*-0.003 [-30.162]	0.000 [-1.018]	0.000 [-0.871]
c_{ii}	0.000 [-0.765]	*0.002 [3.526]	*0.000 [4.163]	0.000 [-0.074]	*-0.001 [-3.313]	0.000 [0.001]	**0.000 [-2.076]
α_{11}	*0.154 [4.392]	*0.227 [11.124]	*0.180 [12.303]	*0.192 [13.299]	*0.097 [3.444]	*0.123 [5.170]	*0.209 [6.449]
α_{il}	-0.017 [-0.730]	0.037 [1.540]	0.000 [-0.371]	-0.021 [-1.142]	*0.614 [17.425]	*-0.226 [-11.719]	-0.045 [-1.212]
α_{i1}	*-0.110 [-2.630]	0.034 [1.346]	**0.1432 [-2.523]	*0.131 [5.442]	*-0.119 [-3.152]	*-0.086 [-3.268]	-0.011 [-0.230]
α_{ii}	*0.195 [7.642]	*0.193 [9.531]	*0.523 [23.522]	*0.313 [13.372]	*1.081 [31.323]	*-0.092 [-3.763]	*0.165 [5.115]
β_{11}	*-0.977 [-106.637]	*0.966 [146.177]	*0.980 [296.868]	*0.976 [312.695]	*1.023 [124.936]	*0.984 [200.740]	*0.973 [107.727]
β_{il}	-0.009 [-1.391]	***-0.014 [-1.941]	0.000 [0.882]	0.004 [0.611]	*-0.261 [-23.333]	-0.004 [-0.754]	0.007 [0.719]
β_{i1}	-0.010 [-0.950]	**0.022 [-2.412]	***0.329 [1.942]	*-0.034 [-4.242]	*0.081 [4.394]	0.007 [1.242]	0.000 [0.036]
β_{ii}	*-0.984 [-152.912]	*0.953 [117.035]	*0.900 [138.127]	*0.940 [98.408]	*0.487 [23.858]	*0.979 [210.516]	*0.984 [113.853]

Table-A.1. Daily VAR-BEKK-GARCH Results (Contd.).

USDCAD	USDCHF	DAX30	USDJPY	NIKKEI225	FTSE100	DOW30
$ar(1)_{11}$	-0.015 [-0.819]	*-0.084 [-4.030]	**0.053 [-2.366]	**0.045 [2.044]	***-0.041 [-1.680]	***-0.042 [-1.712]
$ar(1)_{li}$	-0.024 [-1.473]	0.059 [0.143]	-0.004 [-0.212]	*-0.050 [-3.703]	-0.020 [-1.245]	-0.018 [-1.217]
<i>Constant</i>	0.000 [0.721]	0.000 [1.086]	0.000 [0.527]	*0.000 [4.984]	0.000 [1.018]	0.000 [1.419]
$ar(1)_{il}$	-0.048 [-1.399]	*0.001 [3.151]	0.010 [0.511]	*0.143 [4.731]	**0.073 [2.347]	0.024 [0.770]
$ar(1)_{ii}$	0.024 [0.828]	*-0.067 [-3.094]	-0.004 [-0.169]	*-0.121 [-4.069]	**0.051 [-2.172]	**0.051 [-2.301]
<i>Constant</i>	0.000 [0.198]	0.000 [-0.272]	0.000 [1.551]	*0.001 [10.484]	0.000 [1.563]	0.000 [1.352]
c_{11}	*0.000 [10.078]	*0.000 [13.879]	*0.000 [8.390]	*0.001 [3.844]	*0.000 [-4.384]	*0.000 [-5.872]
c_{il}	*0.002 [174.990]	0.000 [0.544]	0.000 [0.454]	*0.006 [28.208]	***0.000 [1.882]	0.000 [-0.181]
c_{ii}	*0.002 [125.943]	*0.000 [22.667]	*0.001 [6.322]	0.000 [-0.002]	0.000 [0.001]	0.000 [0.002]
α_{11}	*0.190 [46.127]	*0.178 [60.231]	*0.227 [21.084]	*0.247 [18.754]	*0.247 [14.189]	*0.218 [13.966]
α_{il}	*-0.259 [-30.283]	0.000 [0.650]	*-0.057 [-5.460]	*0.360 [6.344]	*0.136 [5.412]	*0.135 [5.535]
α_{i1}	-0.015 [-1.627]	*0.599 [5.133]	*-0.033 [-3.384]	0.019 [0.568]	*-0.046 [-2.812]	-0.009 [-0.729]
α_{ii}	*0.275 [11.423]	*0.518 [124.978]	*0.220 [39.365]	*0.852 [16.981]	*0.114 [7.406]	*0.123 [7.243]
β_{11}	*0.986 [1055.388]	*0.982 [2053.324]	*0.971 [365.596]	*1.008 [75.661]	*0.965 [209.178]	*0.972 [300.377]

β_{li}	*0.088 [14.341]	0.000 [-1.266]	*0.015 [6.031]	*0.400 [6.080]	*-0.024 [-3.750]	*-0.027 [-5.749]
β_{il}	*-0.016 [-4.603]	*-0.107 [-3.003]	0.004 [1.607]	** -0.065 [-2.130]	*0.012 [3.007]	***0.004 [1.727]
β_{ii}	*0.879 [724.342]	*0.902 [798.311]	*0.972 [973.512]	*0.133 [2.608]	*0.992 [348.198]	*0.992 [453.185]

Table-A.1. Daily VAR-BEKK-GARCH Results (Contd.).

USDCHF	DAX30	USDJPY	NIKKEI25	FTSE100	DOW30	DAX30	USDJPY	NIKKEI25	FTSE100	DOW30
$ar(1)_{11}$	***_0.049 [-1.903]	-0.011 [-0.506]	*-0.121 [-5.241]	-0.044 [-1.445]	** -0.033 [-2.527]	$ar(1)_{11}$	** -0.050 [-2.433]	*-0.063 [-2.835]	*-0.058 [-2.616]	** -0.056 [-2.541]
$ar(1)_{li}$	-1.067 [-1.614]	-0.005 [-0.188]	*0.090 [3.753]	0.014 [0.532]	0.008 [0.386]	$ar(1)_{li}$	**0.000 [2.525]	*0.001 [3.178]	*0.001 [2.942]	*0.000 [2.778]
Constant	*0.000 [-2.762]	0.000 [0.272]	*-0.001 [-5.310]	0.000 [-0.241]	0.000 [-1.161]	Constant	0.000 [0.645]	0.000 [-0.455]	0.000 [-0.423]	0.000 [-0.401]
$ar(1)_{il}$	0.000 [1.588]	*-0.050 [-3.614]	*0.067 [2.939]	*0.083 [3.595]	*-0.050 [-5.978]	$ar(1)_{il}$	*-1.299 [-2.994]	-0.047 [-0.110]	-0.549 [-0.971]	-0.561 [-0.912]
$ar(1)_{ii}$	*-0.070 [-2.867]	***0.035 [1.936]	*-0.160 [-6.034]	** -0.049 [-2.207]	0.023 [1.471]	$ar(1)_{ii}$	-0.014 [-0.695]	*-0.106 [-6.378]	** -0.052 [-2.373]	*-0.080 [-3.463]
Constant	0.000 [-1.426]	*0.000 [3.041]	*0.001 [4.367]	***0.000 [1.726]	*0.000 [-12.897]	Constant	***0.000 [1.802]	0.000 [1.601]	0.000 [1.052]	0.000 [1.106]
c_{11}	*0.002 [10.574]	*0.001 [10.674]	*-0.003 [-9.373]	*0.002 [8.944]	*0.001 [51.968]	c_{11}	0.000 [-0.205]	*0.000 [20.808]	*0.000 [7.129]	*0.000 [7.793]
c_{il}	0.000 [0.301]	*0.000 [10.153]	*0.001 [3.028]	0.000 [-1.241]	*0.001 [25.744]	c_{il}	*0.000 [-11.655]	*0.000 [8.697]	0.000 [-0.162]	0.000 [-0.444]
c_{ii}	*0.000 [2.635]	0.000 [0.000]	0.000 [-0.006]	0.000 [0.000]	0.000 [0.000]	c_{ii}	*0.000 [19.809]	*0.000 [38.475]	*0.001 [5.842]	*0.000 [-4.316]
α_{11}	*0.149 [8.424]	*0.127 [37.278]	*0.680 [13.687]	*0.694 [15.332]	*0.049 [10.388]	α_{11}	*0.516 [124.959]	*0.518 [124.440]	*0.524 [23.859]	*0.525 [41.510]
α_{li}	*0.001 [3.039]	*-0.021 [-13.081]	** -0.153 [-2.090]	*0.117 [4.583]	*-0.156 [-57.811]	α_{li}	*0.534 [4.155]	*0.601 [15.449]	0.893 [1.537]	**1.167 [2.095]
α_{il}	**1.155 [2.096]	*0.183 [36.830]	*-0.730 [-19.838]	*-0.649 [-22.395]	*0.268 [40.105]	α_{il}	*-0.001 [-15.116]	*0.000 [4.052]	0.000 [1.181]	0.000 [1.238]
α_{ii}	*0.520 [24.488]	*0.314 [447.182]	*0.293 [4.763]	0.023 [0.970]	*0.483 [711.546]	α_{ii}	*0.154 [77.197]	*0.041 [37.493]	*0.158 [14.802]	*0.155 [14.889]
β_{11}	*0.967 [176.115]	*1.008 [3901.511]	-0.062 [-0.478]	*0.670 [20.645]	*1.048 [1804.501]	β_{11}	*0.905 [817.494]	*0.900 [777.206]	*0.900 [141.999]	*0.899 [225.113]
β_{li}	0.000 [-0.144]	*0.067 [78.806]	*0.748 [7.095]	*-0.070 [-5.539]	*0.188 [50.513]	β_{li}	*-0.129 [-4.002]	-0.003 [-0.379]	-0.155 [-0.858]	-0.215 [-1.271]
β_{il}	** -0.398 [-2.492]	*-0.153 [-394.922]	*0.641 [18.478]	*0.192 [11.787]	*-0.250 [-681.926]	β_{il}	*0.000 [5.281]	*0.000 [-4.075]	0.000 [-0.535]	0.000 [-0.596]
β_{ii}	*0.900 [146.729]	*0.925 [5527.509]	*0.506 [3.507]	*1.026 [171.893]	*0.805 [4043.050]	β_{ii}	*0.985 [3667.046]	*0.997 [26424.496]	*0.985 [471.733]	*0.986 [531.267]

Table-A.1. Daily VAR-BEKK-GARCH Results (Contd.).

USDJPY	NIKKEI25	FTSE100	DOW30	USDMXN	FTSE100	DOW30	USDNOK	DOW30
$ar(1)_{11}$	*-0.080 [-11.148]	-0.002 [-0.101]	0.003 [0.147]	$ar(1)_{11}$	*-0.087 [-2.848]	*-0.127 [-4.848]	$ar(1)_{11}$	-0.003 [-0.105]
$ar(1)_{li}$	-0.013 [-1.172]	-0.016 [-1.012]	-0.019 [-1.314]	$ar(1)_{li}$	-0.010 [-0.399]	0.028 [1.257]	$ar(1)_{li}$	-0.016 [-0.487]
Constant	0.000 [0.643]	***0.000 [1.920]	0.000 [1.216]	Constant	*0.001 [11.003]	*0.001 [3.982]	Constant	0.000 [1.463]

$ar(1)_{il}$	*0.197 [-38.615]	0.016 [0.654]	0.001 [0.050]	$ar(1)_{il}$	0.004 [0.192]	-0.016 [-0.847]	$ar(1)_{il}$	0.019 [0.576]
$ar(1)_{ii}$	*-0.080 [-4.065]	-0.021 [-0.997]	***-0.040 [-1.821]	$ar(1)_{ii}$	-0.021 [-0.929]	**0.047 [-2.416]	$ar(1)_{ii}$	-0.052 [-1.549]
<i>Constant</i>	*0.001 [25.034]	***0.000 [1.673]	0.000 [1.277]	<i>Constant</i>	0.000 [-0.092]	0.000 [0.555]	<i>Constant</i>	0.000 [0.884]
c_{11}	*0.002 [57.349]	*0.001 [35.124]	*0.001 [18.230]	c_{11}	*0.004 [29.096]	*0.004 [23.999]	c_{11}	*0.001 [5.649]
c_{il}	*0.005 [121.467]	***0.000 [-1.936]	0.000 [-0.448]	c_{il}	*0.000 [-5.208]	*-0.001 [-3.715]	c_{il}	**0.000 [2.163]
c_{ii}	0.000 [0.000]	*0.000 [7.052]	***0.000 [1.831]	c_{ii}	0.000 [0.000]	0.000 [0.000]	c_{ii}	*0.000 [5.335]
α_{11}	*0.144 [39.455]	*0.259 [87.127]	*0.238 [41.101]	α_{11}	*1.076 [28.428]	*0.880 [27.032]	α_{11}	*0.167 [6.098]
α_{li}	*-0.611 [-102.046]	*-0.120 [-21.712]	*-0.120 [-6.574]	α_{li}	*0.140 [9.817]	*0.082 [2.992]	α_{li}	-0.019 [-0.609]
α_{rl}	*0.059 [13.224]	**0.007 [2.191]	***-0.012 [-1.717]	α_{rl}	*-0.739 [-21.299]	*-0.722 [-21.529]	α_{rl}	0.016 [0.487]
α_{ri}	*0.775 [184.067]	*0.178 [55.698]	*0.200 [13.891]	α_{ri}	*0.082 [7.400]	*0.123 [5.094]	α_{ri}	*0.201 [6.026]
β_{11}	*0.924 [1206.809]	*0.961 [1727.032]	*0.967 [1123.755]	β_{11}	*0.308 [12.356]	*-0.302 [-8.006]	β_{11}	*0.982 [154.284]
β_{li}	*-0.219 [-47.117]	*0.031 [43.189]	*0.029 [5.614]	β_{li}	*-0.047 [-15.686]	0.008 [0.339]	β_{li}	0.005 [0.562]
β_{rl}	*-0.108 [-70.899]	0.000 [-0.052]	**0.002 [2.040]	β_{rl}	*0.305 [17.306]	*-0.343 [-16.376]	β_{rl}	-0.001 [-0.157]
β_{ri}	*0.332 [46.548]	*0.979 [2200.349]	*0.975 [244.861]	β_{ri}	*1.002 [544.255]	*-0.986 [-90.181]	β_{ri}	*0.976 [114.238]

Table-A.2. 30 Minute VAR-BEKK-GARCH Results.

AUDUS D	EURUS D	GBPUS D	CAC40 CAC40	USDCA D	USDCH F	DAX30 DAX30	USDJP Y	NIKKEI2 25	FTSE1 00	DOW3 0
$ar(1)_{11}$	*-0.051 [-14.280]	*-0.040 [13.085]	*-0.058 [-14.112]	*-0.057 [-15.474]	*-0.045 [-14.926]	*-0.037 [-14.453]	*-0.048 [-18.318]	*-0.052 [-18.449]	*-0.050 [-15.171]	*-0.051 [-15.360]
$ar(1)_{li}$	*0.019 [4.880]	0.005 [1.441]	*0.031 [8.779]	*-0.033 [-8.097]	*-0.010 [-3.599]	***0.066 [1.687]	-0.004 [-1.310]	*-0.023 [-9.250]	*-0.013 [4.766]	*-0.015 [5.698]
<i>Constant</i>	*0.000 [5.267]	*0.000 [4.844]	*0.000 [5.053]	*0.000 [5.248]	*0.000 [4.933]	*0.000 [5.661]	*0.000 [4.395]	*0.000 [9.203]	*0.000 [5.610]	*0.000 [5.385]
$ar(1)_{il}$	*0.013 [5.044]	*0.017 [9.094]	*0.077 [18.136]	*-0.031 [-12.265]	*-0.011 [-4.806]	*-0.001 [13.382]	*-0.006 [-3.954]	*-0.062 [-26.996]	*-0.044 [13.582]	*-0.042 [13.013]
$ar(1)_{ii}$	*-0.044 [-12.039]	*-0.061 [-19.288]	*-0.092 [-23.924]	*-0.071 [-19.802]	*-0.055 [-17.323]	*-0.145 [-47.608]	*-0.043 [-13.915]	*-0.067 [-22.508]	*-0.062 [-19.540]	*-0.051 [-15.837]
<i>Constant</i>	0.000 [0.641]	0 [1.703]	*0.000 [3.307]	*0.000 [3.550]	0.000 [-0.787]	*0.000 [-5.226]	*0.000 [10.053]	*0.000 [-5.234]	**0.000 [1.993]	**0.000 [2.452]
c_{11}	*0.000 [49.550]	*0.000 [47.377]	*0.000 [72.311]	*0.000 [45.382]	*0.000 [61.009]	*0.000 [65.254]	*0.000 [56.632]	*0.000 [56.561]	*0.000 [54.394]	*0.000 [47.286]
c_{il}	*0.000 [32.307]	*0.000 [18.741]	*0.000 [54.308]	*0.000 [-18.589]	*0.000 [27.810]	*0.000 [-3.879]	*0.000 [13.009]	*0.000 [-29.798]	*0.000 [38.702]	*0.000 [34.484]
c_{ii}	*0.000 [56.366]	*0.000 [-53.277]	*0.000 [-25.809]	*0.000 [51.798]	*0.000 [54.016]	*0.000 [39.944]	*0.000 [86.508]	*0.000 [45.139]	*0.000 [45.664]	*0.000 [46.596]
α_{11}	*0.213 [48.688]	*0.214 [55.983]	*0.309 [66.578]	*0.205 [55.268]	*0.229 [78.390]	*0.298 [88.883]	*0.231 [83.245]	*0.244 [66.021]	*0.234 [55.926]	*0.227 [51.017]

α_{ii}	**_									
	0.008	*-0.011	*0.139	*0.039					*-0.057	*-0.043
	[-	[-	[24.573	[11.555	*0.043	*-0.001	*0.027	*-0.051	[-	[-
	2.427]	4.287]	]	]	[14.992]	[-5.051]	[14.807]	[-17.108]	14.990]	9.374]
α_{i1}	*0.079	*0.080		*-0.084	*-0.030				*-0.048	*-0.063
	[19.252	[16.212	0.007	[-	[-	*0.181	*0.020	*-0.042	[-	[-
	]	]	[1.625]	20.477]	12.172]	[5.514]	[5.874]	[-13.992]	15.397]	20.710]
α_{ii}	*0.331	*0.354	*0.183	*0.376	*0.382				*0.297	*0.305
	[89.335	[105.65	[34.013	[110.52	[143.077	*0.234	*0.453	*0.300	[86.237	[87.365
	]	8]	]	2]	]	[96.237]	]	[105.235]]]
β_{11}	*0.974	*0.971	*0.950	*0.973	*0.970	*0.947	*0.967		*0.970	*0.970
	[794.66	[911.90	[684.36	[869.17	[1261.42	[837.884	[1216.78	*0.966	[853.10	[740.45
	3]	1]	0]	7]	0]	]	6]	[935.155]	0]	8]
β_{i1}	*0.005	**0.002	*-0.034	*-0.009	*-0.009				*0.010	*0.008
	[4.947]	[2.062]	[-	[-	[-	*0.000	*-0.004	*0.013	[8.516]	[5.528]
	]	]	22.838]	8.161]	10.367]	[6.463]	[-7.523]	[15.048]]]
β_{i1}	*-0.021	*-0.018	*-0.009	*0.018					*0.016	*0.019
	[-	[-	[-	[14.346	*0.011	*-0.071	0.000	*0.012	[16.422	[18.859
	17.356]	11.134]	7.413]	]	[13.995]	[-9.046]	[0.104]	[12.445]]]
β_{ii}	*0.939	*0.942	*0.973	*0.936	*0.932	*0.974	*0.899	*0.950	*0.944	*0.944
	[795.68	[917.74	[712.68	[872.01	[1070.91	[1920.28	[663.991	[1097.862	[838.11	[834.73
	4]	7]	7]	3]	5]	1]	]	]	4]	3]

Table-A.2. 30 Minute VAR-BEKK-GARCH Results (Contd.)

EURUSD	GBPUSD	CAC40	USDCA D	USDCHF	DAX30	USDJPY	NIKKEI22 5	FTSE100	DOW30
$ar(1)_{11}$	*-0.029	*-0.036	*-0.037	*-0.054	*-0.027	*-0.033	*-0.031	*-0.028	*-0.027
	[-8.469]	[-13.815]	[-13.515]	[-25.152]	[-10.616]	[-11.821]	[-10.221]	[-6.525]	[-5.893]
$ar(1)_{li}$	0.005	*0.009	*-0.017	*-0.018	-0.002	*-0.009	-0.002	-0.001	0.001
	[1.411]	[6.853]	[-11.277]	[-9.527]	[-0.047]	[-3.423]	[-0.819]	[-0.230]	[0.391]
Constant	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	[0.785]	[0.651]	[-0.076]	[0.109]	[0.713]	[0.039]	[1.368]	[0.821]	[0.736]
$ar(1)_{i1}$	*0.028	*0.041	*-0.028	*-0.062	*-0.002	*-0.006	*-0.067	*-0.051	*-0.045
	[10.049]	[20.399]	[-16.729]	[-25.093]	[-14.509]	[-3.125]	[-23.724]	[-9.328]	[-7.607]
$ar(1)_{ii}$	*-0.066	*-0.061	*-0.056	*-0.099	*-0.144	*-0.044	*-0.069	*-0.069	*-0.056
	[-19.959]	[-24.044]	[-26.671]	[-38.297]	[-46.986]	[-13.794]	[-22.623]	[-15.922]	[-12.403]
Constant	0.000	*0.000	*0.000	0.000	*0.000	*0.000	*0.000	*0.000	**0.000
	[0.927]	[3.437]	[-2.629]	[-1.049]	[-4.939]	[10.606]	[-4.352]	[-2.771]	[-2.044]
c_{11}	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000
	[61.838]	[67.231]	[64.681]	[106.074]	[65.272]	[67.754]	[66.972]	[66.120]	[62.149]
c_{i1}	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000
	[31.130]	[27.905]	[-19.916]	[-106.886]	[-4.703]	[-14.471]	[-15.142]	[-36.075]	[-32.554]
c_{ii}	*0.000	*0.000	*0.000	0.000	*0.000	*0.000	*0.000	*0.000	*0.000
	[-53.809]	[38.379]	[51.337]	[0.011]	[41.916]	[83.607]	[69.019]	[-70.685]	[59.055]
α_{11}	*0.270	*0.328	*0.289	*0.262	*0.314	*0.280	*0.302	*0.298	*0.280
	[49.242]	[102.129]	[86.138]	[128.485]	[117.834]	[118.819]	[105.997]	[67.162]	[53.032]
α_{i1}	*-0.027	*0.119	0.003	*0.028	*-0.001	*0.051	*-0.053	*-0.029	0.008
	[-6.776]	[32.172]	[0.746]	[17.269]	[-3.466]	[22.255]	[-17.170]	[-4.424]	[1.135]
α_{i1}	*0.045	-0.001	*-0.017	*-0.050	-0.009	*-0.031	*-0.010	0.000	*-0.016
	[4.959]	[-0.210]	[-4.351]	[-22.156]	[-0.326]	[-10.665]	[-4.344]	[-0.091]	[-3.550]
α_{ii}	*0.358	*0.170	*0.337	*0.361	*0.232	*0.455	*0.301	*0.305	*0.331
	[67.261]	[50.833]	[93.721]	[160.020]	[100.415]	[131.719]	[113.618]	[61.006]	[59.212]
β_{11}	*0.958	*0.942	*0.951	*0.960	*0.946	*0.956	*0.951	*0.953	*0.955
	[521.624	[937.100]	[923.969	[2291.429	[1079.780	[1391.493	[1047.966]	[569.922	[420.331
]]]]]]]]]
β_{i1}	*0.005	*-0.031	***0.003	*0.008	*0.000	*-0.013	*0.010	-0.003	*-0.011
	[3.406]	[-27.696]	[1.848]	[25.894]	[3.788]	[-15.747]	[9.373]	[-1.041]	[-3.837]
β_{i1}	*-0.013	0.001	0.002	*0.016	-0.009	*0.014	*0.004	0.002	***0.003
	[-4.015]	[0.962]	[1.316]	[26.732]	[-1.388]	[12.957]	[6.068]	[1.301]	[1.709]
β_{ii}	*0.942	*0.983	*0.947	*0.943	*0.975	*0.898	*0.950	*0.940	*0.934
	[502.503	[1198.247	[850.345	[1408.784	[2064.177	[676.160]	[1234.086]	[484.417	[400.867
]]]]]]]]]

Table-A.2. 30 Minute VAR-BEKK-GARCH Results (Contd.)

GBPUSD	CAC40	USDCAD	USDCHF	DAX30	USDJPY	NIKKEI225	FTSE100	DOW30
$ar(1)_{11}$	*-0.052 [-16.493]	*-0.058 [-21.720]	*-0.051 [-15.929]	*-0.042 [-15.445]	*-0.045 [-16.252]	*-0.047 [-17.087]	*-0.058 [-18.319]	*-0.055 [-17.298]
$ar(1)_{li}$	*0.010 [5.148]	*-0.023 [-12.586]	*-0.010 [-4.812]	-0.039 [-1.442]	*-0.008 [-2.607]	*-0.007 [-3.936]	*-0.018 [-9.730]	*-0.016 [-8.652]
Constant	0.000 [1.443]	0.000 [0.736]	0.000 [0.731]	0.000 [1.396]	0.000 [1.466]	**0.000 [2.034]	0.000 [1.195]	0.000 [1.086]
$ar(1)_{i1}$	*0.026 [6.150]	*-0.016 [-6.519]	*-0.021 [-5.674]	*-0.002 [-10.638]	*-0.011 [-5.326]	*-0.049 [-18.116]	*-0.036 [-8.108]	*-0.034 [-7.711]
$ar(1)_{ii}$	*-0.051 [-15.582]	*-0.046 [-19.168]	*-0.056 [-17.491]	*-0.144 [-45.120]	*-0.040 [-13.313]	*-0.051 [-18.233]	*-0.051 [-16.213]	*-0.038 [-12.320]
Constant	*0.000 [3.372]	*0.000 [-2.665]	0.000 [-0.949]	*0.000 [-4.428]	*0.000 [10.018]	*0.000 [-4.715]	0.000 [-1.553]	**0.000 [-2.230]
c_{11}	*0.000 [53.968]	*0.000 [54.388]	*0.000 [59.791]	*0.000 [55.270]	*0.000 [56.100]	*0.000 [-53.651]	*0.000 [52.292]	*0.000 [52.933]
c_{i1}	*0.000 [14.746]	*0.000 [-31.300]	*0.000 [-40.132]	***0.000 [-1.883]	0.000 [-1.591]	*0.000 [8.712]	*0.000 [-24.086]	*0.000 [-22.321]
c_{ii}	*0.000 [34.940]	*0.000 [-47.972]	*0.000 [-49.744]	*0.000 [42.304]	*0.000 [78.810]	*0.000 [76.645]	*0.000 [54.323]	*0.000 [63.170]
α_{11}	*0.362 [129.745]	*0.346 [103.477]	*0.289 [114.092]	*0.334 [137.211]	*0.299 [139.667]	*0.318 [125.080]	*0.329 [86.472]	*0.321 [91.150]
α_{i1}	*0.115 [24.647]	*-0.065 [-14.423]	*0.101 [20.355]	*0.000 [-2.650]	*0.060 [20.243]	*-0.036 [-8.817]	**0.027 [-2.151]	0.005 [0.545]
α_{i1}	*-0.019 [-9.813]	*0.009 [3.082]	*-0.015 [-8.803]	-0.012 [-0.594]	*-0.015 [-6.095]	*-0.007 [-4.783]	0.004 [1.644]	0.002 [1.053]
α_{ii}	*0.161 [52.958]	*0.295 [82.487]	*0.386 [129.186]	*0.228 [100.837]	*0.450 [131.673]	*0.307 [119.418]	*0.286 [69.960]	*0.304 [83.238]
β_{11}	*0.940 [1104.731]	*0.940 [879.488]	*0.962 [1436.964]	*0.946 [1325.050]	*0.957 [1744.664]	*0.952 [1272.560]	*0.953 [723.918]	*0.955 [856.067]
β_{i1}	*-0.028 [-18.672]	*0.030 [18.541]	*-0.026 [-16.251]	*0.000 [2.940]	*-0.020 [-19.772]	*0.006 [4.202]	-0.003 [-0.744]	*-0.014 [-4.960]
β_{i1}	*0.004 [6.525]	*-0.008 [-7.594]	*0.010 [14.727]	-0.007 [-1.283]	*0.007 [7.798]	*0.003 [7.971]	*0.005 [4.557]	*0.004 [4.926]
β_{ii}	*0.985 [1362.664]	*0.959 [930.618]	*0.927 [880.962]	*0.976 [2093.096]	*0.898 [641.624]	*0.949 [1203.624]	*0.948 [642.163]	*0.943 [708.409]

Table-A.2. 30 Minute VAR-BEKK-GARCH Results (Contd.)

CAC40	USDCAD	USDCHF	DAX30	USDJPY	NIKKEI225	FTSE100	DOW30
$ar(1)_{11}$	*-0.066 [-20.765]	*-0.050 [-17.590]	*-0.040 [-12.920]	*-0.045 [-17.538]	*-0.055 [-21.224]	*-0.058 [-22.594]	*-0.060 [-19.455]
$ar(1)_{li}$	*-0.057 [-14.064]	*-0.021 [-6.685]	0.025 [0.573]	*-0.010 [-2.886]	*-0.026 [-9.098]	*-0.027 [-10.989]	*-0.031 [-11.148]
Constant	*0.000 [3.374]	*0.000 [3.159]	*0.000 [2.824]	*0.000 [3.812]	*0.000 [3.786]	*0.000 [3.458]	*0.000 [3.384]
$ar(1)_{i1}$	*-0.019 [-9.224]	*-0.012 [-5.770]	*-0.001 [-9.565]	0.000 [0.124]	*-0.044 [-26.861]	*-0.036 [-14.908]	*-0.032 [-11.085]
$ar(1)_{ii}$	*-0.055 [-16.168]	*-0.057 [-18.076]	*-0.144 [-45.368]	*-0.042 [-14.063]	*-0.057 [-19.427]	*-0.057 [-20.129]	*-0.044 [-14.506]
Constant	*0.000 [-3.410]	0.000 [-1.159]	*0.000 [-4.330]	*0.000 [10.217]	*0.000 [-4.491]	***0.000 [-1.762]	**0.000 [-2.214]
c_{11}	*0.000 [36.625]	*0.000 [47.114]	*0.000 [42.428]	*0.000 [43.669]	*0.000 [34.872]	*0.000 [42.285]	*0.000 [34.141]
c_{i1}	*0.000 [-22.851]	*0.000 [-28.889]	**0.000 [-2.068]	*0.000 [-5.420]	*0.000 [-30.263]	*0.000 [-39.203]	*0.000 [-35.491]
c_{ii}	*0.000 [31.052]	*0.000 [33.400]	*0.000 [43.715]	*0.000 [79.196]	*0.000 [37.612]	*0.000 [-33.844]	*0.000 [35.434]
α_{11}	*0.149 [50.349]	*0.189 [79.966]	*0.249 [64.676]	*0.202 [80.869]	*0.160 [52.338]	*0.173 [55.333]	*0.165 [48.653]
α_{i1}	*0.035	*0.031	0.000	*0.046	*-0.023	*-0.027	*-0.011

	[15.425]	[10.346]	[0.967]	[27.242]	[-9.685]	[-7.498]	[-2.775]
α_{i1}	*-0.131 [-31.745]	*-0.048 [-18.810]	*0.210 [5.826]	*0.015 [3.919]	*-0.085 [-34.526]	*-0.093 [-32.261]	*-0.103 [-34.532]
α_{ii}	*0.377 [119.822]	*0.376 [125.905]	*0.243 [97.730]	*0.457 [130.496]	*0.326 [129.341]	*0.316 [94.776]	*0.330 [99.884]
β_{11}	*0.986 [1435.121]	*0.979 [1702.382]	*0.962 [796.257]	*0.976 [1556.769]	*0.986 [1612.813]	*0.983 [1315.480]	*0.984 [1205.122]
β_{1i}	*-0.005 [-6.627]	*-0.004 [-5.525]	0.000 [1.142]	*-0.008 [-12.754]	*0.004 [6.384]	*0.005 [5.057]	**0.002 [2.113]
β_{i1}	*0.030 [26.340]	*0.015 [20.082]	*-0.077 [-8.968]	-0.001 [-0.605]	*0.022 [32.705]	*0.027 [29.601]	*0.027 [28.405]
β_{ii}	*0.936 [973.918]	*0.933 [999.018]	*0.972 [1795.053]	*0.896 [642.865]	*0.942 [1288.174]	*0.941 [837.558]	*0.939 [828.231]

Table-A.2. 30 Minute VAR-BEKK-GARCH Results (Contd.)

USDCAD	USDCHF	DAX30	USDJPY	NIKKEI225	FTSE100	DOW30
$ar(1)_{11}$	*-0.044 [-15.267]	*-0.034 [-10.430]	*-0.041 [-15.037]	*-0.051 [-16.963]	*-0.050 [-16.297]	*-0.049 [-16.146]
$ar(1)_{li}$	*0.009 [4.088]	**0.065 [1.981]	*-0.008 [-3.021]	*0.015 [7.225]	*0.015 [8.784]	*0.015 [7.777]
Constant	*0.000 [-3.884]	**0.000 [-2.185]	*0.000 [-2.709]	*0.000 [-3.205]	*0.000 [-2.956]	*0.000 [-3.554]
$ar(1)_{i1}$	*0.017 [5.901]	*0.001 [8.088]	-0.001 [-0.734]	*0.069 [26.638]	*0.048 [13.586]	*0.048 [13.116]
$ar(1)_{ii}$	*-0.053 [-17.837]	*-0.141 [-45.505]	*-0.042 [-13.188]	*-0.066 [-24.327]	*-0.057 [-19.443]	*-0.046 [-15.124]
Constant	0.000 [-0.039]	*0.000 [-3.779]	*0.000 [11.760]	*0.000 [-4.496]	0.000 [-1.591]	**0.000 [-2.003]
c_{11}	*0.000 [55.235]	*0.000 [56.835]	*0.000 [58.393]	*0.000 [58.747]	*0.000 [57.446]	*0.000 [-55.524]
c_{i1}	*0.000 [31.389]	*0.000 [8.083]	*0.000 [4.102]	*0.000 [23.640]	*0.000 [24.704]	*0.000 [-22.000]
c_{ii}	*0.000 [54.911]	*0.000 [37.746]	*0.000 [77.071]	*0.000 [68.287]	*0.000 [57.109]	*0.000 [53.172]
α_{11}	*0.302 [120.905]	*-0.340 [-122.887]	*0.296 [126.337]	*0.308 [106.637]	*0.332 [108.580]	*0.320 [102.150]
α_{1i}	*-0.025 [-6.408]	*-0.001 [-5.336]	*-0.035 [-12.101]	*0.062 [23.016]	*0.070 [14.761]	*0.050 [11.246]
α_{i1}	0.003 [1.464]	*0.125 [4.632]	*-0.010 [-3.469]	*0.027 [13.205]	*0.011 [3.984]	*0.028 [10.906]
α_{ii}	*0.370 [124.188]	*0.223 [92.997]	*0.441 [122.395]	*0.298 [121.334]	*0.275 [85.599]	*0.287 [93.055]
β_{11}	*0.956 [1392.574]	*0.942 [1099.613]	*0.956 [1495.494]	*0.954 [1147.019]	*0.948 [1020.742]	*0.950 [989.419]
β_{1i}	*0.004 [3.534]	*0.000 [-3.673]	*0.008 [8.385]	*-0.014 [-17.994]	*-0.015 [-10.507]	*-0.010 [-6.916]
β_{i1}	*-0.005 [-6.788]	0.002 [0.335]	0.000 [-0.431]	*-0.009 [-14.242]	*-0.006 [-6.743]	*-0.010 [-10.462]
β_{ii}	*0.933 [1000.181]	*0.976 [1998.607]	*0.902 [637.892]	*0.951 [1370.821]	*0.953 [907.698]	*0.951 [959.571]

Table-A.2. 30 Minute VAR-BEKK-GARCH Results (Contd.)

USDC HF	DAX30	USDJP Y	NIKKEI 225	FTSE1 00	DOW3 0	DAX30	USDJP Y	NIKKEI 225	FTSE10 0	DOW3 0
$ar(1)_{11}$	*-0.044 [-15.151]	*-0.050 [-17.200]	*-0.056 [-22.961]	*-0.057 [-17.629]	*-0.056 [-16.944]	$ar(1)_{11}$	*-0.142 [-52.317]	*-0.141 [-45.670]	*-0.144 [-43.664]	*-0.143 [-45.591]
$ar(1)_{li}$	-0.021 [-0.708]	*0.021 [7.199]	*0.009 [4.118]	*0.016 [6.691]	*0.012 [4.486]	$ar(1)_{li}$	0.000 [0.335]	*0.001 [9.523]	*0.001 [11.998]	*0.001 [13.455]

<i>Constant</i>	0.000 [-0.656]	***0.000 0 [1.717]	0.000 [-0.943]	0.000 [-0.772]	0.000 [-1.622]	<i>Constant</i>	*0.000 [-4.279]	*0.000 [-4.297]	*0.000 [-6.072]	*0.000 [-5.212]
$ar(1)_{il}$	*0.001 [8.466]	*0.005 [3.050]	*0.026 [12.476]	*0.016 [4.535]	*0.018 [5.304]	$ar(1)_{il}$	0.029 [1.135]	**0.066 [1.988]	0.017 [0.441]	-0.006 [-0.138]
$ar(1)_{ii}$	*-0.141 [-48.953]	*-0.043 [-13.196]	*-0.048 [-18.471]	*-0.052 [-15.545]	*-0.043 [-13.499]	$ar(1)_{ii}$	*-0.032 [-9.445]	*-0.041 [-14.319]	*-0.042 [-15.317]	*-0.031 [-10.744]
<i>Constant</i>	*0.000 [-4.364]	*0.000 [11.076]	*0.000 [-5.621]	**0.000 [-2.439]	***0.000 0 [-1.908]	<i>Constant</i>	*0.000 [10.604]	*0.000 [-5.469]	***0.000 0 [-1.865]	***0.000 0 [-1.820]
c_{11}	*0.000 [68.367]	*0.000 [-64.836]	*0.000 [71.999]	*0.000 [70.396]	*0.000 [69.187]	c_{11}	*0.000 [41.326]	*0.000 [42.084]	*0.000 [44.295]	*0.000 [42.936]
c_{i1}	*0.000 [-2.886]	*0.000 [-24.144]	*0.000 [10.961]	*0.000 [51.344]	*0.000 [50.865]	c_{i1}	0.000 [0.800]	0.000 [0.820]	0.000 [-0.855]	**0.000 [1.980]
c_{ii}	*0.000 [35.154]	*0.000 [84.336]	*0.000 [83.614]	*0.000 [47.706]	*0.000 [45.599]	c_{ii}	*0.000 [76.373]	*0.000 [76.367]	*0.000 [62.951]	*0.000 [65.171]
α_{11}	*0.373 [129.142]	*0.326 [126.396]	*0.350 [135.134]	*0.361 [112.543]	*0.356 [112.910]	α_{11}	*0.222 [95.960]	*0.232 [92.707]	*0.230 [96.058]	*0.232 [99.343]
α_{i1}	*-0.001 [-5.250]	**0.004 [2.185]	***0.004 [1.667]	*0.041 [12.683]	*0.030 [9.298]	α_{i1}	*0.341 [14.062]	0.000 [-0.017]	*-0.147 [-3.630]	-0.012 [-0.306]
α_{i1}	-0.035 [-1.110]	*0.078 [23.765]	0.000 [0.110]	*-0.011 [-3.167]	-0.001 [-0.456]	α_{i1}	0.000 [-0.093]	***0.000 [1.774]	**0.000 [-2.042]	0.000 [1.498]
α_{ii}	*0.222 [94.720]	*0.439 [124.493]	*0.307 [145.653]	*0.280 [89.558]	*0.292 [98.285]	α_{ii}	*0.471 [123.933]	*0.324 [121.059]	*0.316 [114.171]	*0.318 [126.778]
β_{11}	*0.929 [927.034]	*0.945 [1154.199]	*0.939 [1037.457]	*0.937 [959.748]	*0.939 [941.217]	β_{11}	*0.977 [2120.432]	*0.975 [1854.563]	*0.975 [2037.761]	*0.975 [2080.523]
β_{i1}	*0.000 [6.170]	0.001 [1.112]	0.001 [0.608]	*-0.016 [-15.674]	*-0.012 [-12.553]	β_{i1}	*-0.059 [-7.583]	0.008 [1.256]	*0.054 [5.719]	**0.019 [2.070]
β_{i1}	0.012 [1.629]	*-0.030 [-25.305]	**0.002 [-2.279]	*-0.004 [-4.077]	*-0.005 [-5.404]	β_{i1}	0.000 [0.470]	0.000 [-1.332]	0 [1.830]	0.000 [-1.468]
β_{ii}	*0.977 [2130.507]	*0.902 [668.233]	*0.950 [1542.825]	*0.955 [940.979]	*0.953 [1069.453]	β_{ii}	*0.890 [604.813]	*0.945 [1141.139]	*0.943 [955.055]	*0.943 [1095.674]

Table-A.2. 30 Minute VAR-BEKK-GARCH Results (Contd.).

USDJPY	NIKKEI225	FTSE100	DOW30	USDMXN	FTSE100	DOW30	USDNOK	DOW30
$ar(1)_{11}$	*-0.075 [-23.793]	*-0.046 [-15.287]	*-0.038 [-11.809]	$ar(1)_{11}$	*-0.061 [-20.658]	*-0.061 [-20.238]	$ar(1)_{11}$	*-0.084 [-21.256]
$ar(1)_{li}$	*0.082 [56.821]	*0.014 [10.249]	0.001 [1.010]	$ar(1)_{li}$	*0.040 [22.552]	*0.041 [20.195]	$ar(1)_{li}$	*0.060 [15.445]
<i>Constant</i>	*0.000 [9.712]	*0.000 [12.546]	*0.000 [10.043]	<i>Constant</i>	*0.000 [-6.484]	*0.000 [-5.371]	<i>Constant</i>	***0.000 [-1.864]
$ar(1)_{i1}$	**0.007 [-2.571]	-0.004 [-1.101]	**0.008 [-2.532]	$ar(1)_{i1}$	*0.019 [8.020]	*0.015 [5.519]	$ar(1)_{i1}$	*0.055 [14.166]
$ar(1)_{ii}$	*-0.042 [-14.518]	*-0.044 [-16.410]	*-0.034 [-13.636]	$ar(1)_{ii}$	*-0.049 [-16.535]	*-0.036 [-12.052]	$ar(1)_{ii}$	*-0.070 [-17.128]

<i>Constant</i>	*0.000 [-4.282]	**0.000 [-2.513]	0.000 [-1.330]	<i>Constant</i>	*0.000 [-2.846]	*0.000 [-3.095]	<i>Constant</i>	**0.000 [-2.089]
c_{11}	*0.000 [80.943]	*0.000 [83.530]	*0.000 [82.843]	c_{11}	*0.000 [73.017]	*0.000 [71.927]	c_{11}	*0.000 [62.189]
c_{i1}	*0.000 [3.406]	*0.000 [6.767]	*0.000 [11.220]	c_{i1}	*0.000 [17.359]	*0.000 [13.417]	c_{i1}	*0.000 [44.361]
c_{ii}	*0.000 [68.028]	*0.000 [57.885]	*0.000 [63.651]	c_{ii}	*0.000 [53.015]	*0.000 [53.568]	c_{ii}	*0.000 [39.332]
α_{11}	*0.505 [130.797]	*0.456 [124.640]	*0.452 [128.460]	α_{11}	*0.302 [118.195]	*0.300 [115.334]	α_{11}	*0.261 [48.215]
α_{1i}	*-0.045 [-14.854]	0.005 [1.225]	*0.028 [7.476]	α_{1i}	*0.035 [12.320]	*0.028 [9.511]	α_{1i}	*0.046 [8.836]
α_{i1}	*0.016 [5.182]	*0.007 [3.709]	*-0.039 [-23.899]	α_{i1}	*0.042 [16.558]	*0.043 [16.196]	α_{i1}	*0.081 [14.511]
α_{ii}	*0.293 [131.546]	*0.274 [109.273]	*0.272 [110.255]	α_{ii}	*0.286 [95.375]	*0.293 [94.481]	α_{ii}	*0.294 [58.550]
β_{11}	*0.873 [490.346]	*0.895 [607.710]	*0.898 [639.883]	β_{11}	*0.950 [1226.367]	*0.950 [1165.752]	β_{11}	*0.956 [522.478]
β_{1i}	*0.013 [10.173]	*-0.006 [-3.880]	*-0.015 [-10.694]	β_{1i}	*-0.011 [-12.768]	*-0.009 [-9.452]	β_{1i}	*-0.015 [-8.915]
β_{i1}	*-0.006 [-6.269]	0.000 [-0.026]	*0.009 [15.128]	β_{i1}	*-0.009 [-10.149]	*-0.009 [-8.954]	β_{i1}	*-0.021 [-10.895]
β_{ii}	*0.955 [1518.636]	*0.957 [1240.616]	*0.958 [1349.796]	β_{ii}	*0.954 [988.275]	*0.953 [956.919]	β_{ii}	*0.952 [569.675]

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