



Research article

**On macroeconomic determinants of co-movements among
international stock markets: evidence from DCC-MIDAS approach**

Arifenuş G ng r* and H seyin Tařtan

Department of Economics, Yildiz Technical University, Istanbul 34220, Turkey

* **Correspondence:** Email: anurgungor@gmail.com.

Supplementary

Appendix A

Table A.1. Estimation results of the POLS models for G7 country pairs.

Dccmidascorr	Model 1	Model 2	Model 3
Bilateral trade	0.6687***(0.048)	0.9553***(0.062)	0.9403***(0.062)
GDP growth rate	-0.0081**(0.003)	-0.0082**(0.004)	-0.0074*(0.004)
Inflation rate	-0.0458***(0.004)	-0.0387***(0.004)	-0.0381***(0.004)
Term spread	-0.0162***(0.004)	-0.0400***(0.005)	-0.0416***(0.005)
CDS risk premium		0.0387***(0.003)	0.0393***(0.003)
Economic policy uncertainty		0.0204***(0.005)	0.0208***(0.005)
S&P 500 volatility	0.6374***(0.121)		-0.0416(0.167)
Volatility ratio			-0.0181**(0.007)
Global financial crisis dummy	-0.0319**(0.014)	-0.0370**(0.017)	-0.0325(0.021)
Trend	-0.0010***(0.0003)	-0.0050***(0.0005)	-0.0049***(0.0005)
Constant	0.4265***(0.011)	0.3710***(0.029)	0.3843***(0.030)
Number of country pairs	21	21	21
Number of observations	1071	783	783
Adjusted R ²	0.286	0.437	0.440
F statistics	62.49***	77.16***	62.59***

Notes: *Dccmidascorr* is the dependent variable. *Bilateral trade* shows the ratio of total mutual trade between countries to their total foreign trade volume. *GDP growth rate* indicates the log transformation of the GDP growth rate differences, *inflation rate* indicates the log transformation of the inflation rate differences, *term spread* indicates the log transformation of the term spread differences, *CDS risk premium* indicates the log transformation of the five-year CDS risk premium differences, and finally, *EPU* shows the log transformation of the economy policy uncertainty index differences between country x and country y . The numbers in the parentheses are standard errors. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table A.2. Estimation results of the POLS models for G7&BRICS-T country pairs.

Dccmidascorr	Model 1	Model 2	Model 3
Bilateral trade	-0.3956***(0.103)	-0.2728**(0.116)	-0.2953**(0.115)
GDP growth rate	-0.0292***(0.002)	-0.0212***(0.003)	-0.0229***(0.003)
Inflation rate	0.0391***(0.003)	0.0281***(0.004)	0.0299***(0.004)
Term spread	-0.0017(0.003)	-0.0158***(0.004)	-0.0173***(0.004)
CDS risk premium		0.0472***(0.004)	0.0406***(0.005)
Economic policy uncertainty		0.0051(0.005)	0.0046(0.005)
S&P 500 volatility	0.7949***(0.088)		0.1039(0.156)
Volatility ratio			-0.0558***(0.013)
Global financial crisis dummy	-0.0368***(0.010)	-0.1312***(0.015)	-0.1274***(0.017)
Trend	-0.0009***(0.0002)	-0.0068***(0.0004)	-0.0065***(0.0005)
Constant	0.3340***(0.010)	0.3407***(0.031)	0.3977***(0.034)
<i>Number of country pairs</i>	42	28	28
<i>Number of observations</i>	2142	948	948
<i>Adjusted R²</i>	0.168	0.374	0.384
<i>F statistics</i>	62.89***	71.91***	60.09***

Notes: *Dccmidascorr* is the dependent variable. *Bilateral trade* shows the ratio of total mutual trade between countries to their total foreign trade volume. *GDP growth rate* indicates the log transformation of the GDP growth rate differences, *inflation rate* indicates the log transformation of the inflation rate differences, *term spread* indicates the log transformation of the term spread differences, *CDS risk premium* indicates the log transformation of the five-year CDS risk premium differences, and finally, *EPU* shows the log transformation of the economy policy uncertainty index differences between country x and country y . The numbers in the parentheses are standard errors. ***, ** indicate statistical significance at the 1%, 5% level, respectively.

Table A.3. Estimation results of the System GMM models for G7 country pairs.

$(Dccmidascorr)_t$	Model 1	Model 2	Model 3
$(Dccmidascorr)_{t-1}$	1.2908***(0.088)	1.3096***(0.135)	1.2716***(0.118)
$(Dccmidascorr)_{t-2}$	-0.4907***(0.154)	-0.4991***(0.110)	-0.7206***(0.216)
$(Dccmidascorr)_{t-3}$	0.4608***(0.124)	0.3717***(0.123)	0.6915***(0.171)
$(Dccmidascorr)_{t-4}$	-0.2901**(0.115)	-0.2771***(0.074)	-0.2633**(0.127)
Bilateral trade	-0.4112(1.305)	0.2613(0.993)	-2.7579(1.876)
GDP growth rate	-0.0011***(0.0003)	-0.0004(0.0003)	-0.0006**(0.0003)
Inflation rate	-0.0019**(0.0008)	-0.0031***(0.0007)	-0.0022***(0.0008)
Term spread	-0.0032***(0.0008)	-0.0042***(0.0009)	-0.0044***(0.001)
CDS risk premium		0.0033***(0.0008)	0.0027**(0.001)
Economic policy uncertainty		-0.0028***(0.0008)	-0.0031***(0.0008)
S&P 500 volatility	0.1022***(0.027)		0.1392*(0.080)
Volatility ratio			-0.0022(0.002)
Global financial crisis dummy	-0.0022(0.003)	0.0025(0.003)	-0.0086*(0.004)
Trend	-0.0002(0.0002)	-0.0002(0.0003)	-0.0001(0.0003)
Constant	0.0403(0.085)	0.0343(0.117)	0.1813(0.140)
<i>Number of country pairs</i>	21	21	21
<i>Number of observations</i>	1071	783	783
<i>Number of instruments</i>	101	96	98
<i>Wald statistics</i>	2235.44***	5461.17***	7859.04***
<i>AR(1) Arellano-Bond prob</i>	0.001	0.002	0.009
<i>AR(2) Arellano-Bond prob</i>	0.451	0.641	0.115
<i>AR(3) Arellano-Bond prob</i>	0.074	0.387	0.064
<i>Sargan test prob</i>	0.999	0.999	0.998

Notes: *Dccmidascorr* is the dependent variable. *Bilateral trade* shows the ratio of total mutual trade between countries to their total foreign trade volume. *GDP growth rate* indicates the log transformation of the GDP growth rate differences, *inflation rate* indicates the log transformation of the inflation rate differences, *term spread* indicates the log transformation of the term spread differences, *CDS risk premium* indicates the log transformation of the five-year CDS risk premium differences, and finally, *EPU* shows the log transformation of the economy policy uncertainty index differences between country x and country y . The numbers in the parentheses are standard errors. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table A.4. Estimation results of the system GMM models for G7&BRICS-T country pairs.

$(Dccmidascorr)_t$	Model 1	Model 2	Model 3
$(Dccmidascorr)_{t-1}$	1.3339***(0.016)	1.3304***(0.033)	1.4048***(0.042)
$(Dccmidascorr)_{t-2}$	-0.4788***(0.022)	-0.3964***(0.043)	-0.5630***(0.053)
$(Dccmidascorr)_{t-3}$	0.0726***(0.010)		0.0906(0.055)
Bilateral trade	-0.0522(0.474)	-0.4752(0.373)	0.3818(1.150)
GDP growth rate	-0.0020***(0.0002)	-0.0029***(0.0003)	-0.0037***(0.0006)
Inflation rate	0.0012(0.0008)	-0.0021*(0.001)	0.0002(0.001)
Term spread	-0.0024***(0.0002)	-0.0014***(0.0006)	-0.0022***(0.0007)
CDS risk premium		0.0116***(0.001)	0.0070***(0.001)
Economic policy uncertainty		0.0003(0.001)	-0.0015(0.001)
S&P 500 volatility	0.1010***(0.005)		0.2249***(0.038)
Volatility ratio			-0.0134***(0.002)
Global financial crisis dummy	-0.0004(0.0008)	-0.0088***(0.002)	-0.0196***(0.003)
Trend	-0.0002***(0.00004)	-0.0008***(0.00009)	-0.0004***(0.0001)
Constant	0.0298*(0.015)	0.0230(0.023)	0.0062(0.052)
Number of country pairs	42	28	28
Number of observations	2142	948	948
Number of instruments	103	96	98
Wald statistics	51162.17***	8686.90***	12976.39***
AR(1) Arellano-Bond prob	0.000	0.000	0.000
AR(2) Arellano-Bond prob	0.094	0.098	0.298
AR(3) Arellano-Bond prob	0.103	0.154	0.232
Sargan test prob	0.999	0.998	0.999

Notes: *Dccmidascorr* is the dependent variable. *Bilateral trade* shows the ratio of total mutual trade between countries to their total foreign trade volume. *GDP growth rate* indicates the log transformation of the GDP growth rate differences, *inflation rate* indicates the log transformation of the inflation rate differences, *term spread* indicates the log transformation of the term spread differences, *CDS risk premium* indicates the log transformation of the five-year CDS risk premium differences, and finally, *EPU* shows the log transformation of the economy policy uncertainty index differences between country *x* and country *y*. The numbers in the parentheses are standard errors. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Appendix B

Table B.1. Parameter estimates of the DCC-MIDAS models based on the GARCH-MIDAS model with rolling window realized volatility for all country pairs.

<i>Dcc-Midas Parameters</i>	<i>a</i>	<i>b</i>	ω	<i>LL</i>	<i>AIC</i>	<i>BIC</i>
S&P500 vs. DAX30	0.019*** (0.002)	0.963*** (0.006)	2.163*** (0.825)	-8476.1	16958.1	16977.1
S&P500 vs. FTSE	0.007** (0.002)	0.939*** (0.052)	4.442*** (1.164)	-9107.2	18400.1	18419.5
S&P500 vs. CAC40	0.015*** (0.002)	0.943*** (0.023)	2.962*** (0.775)	-8764.1	17434.3	17453.1
S&P500 vs. FTSE MIB	0.011* (0.002)	0.946*** (0.028)	7.626*** (1.971)	-9359.9	18725.9	18744.9
S&P500 vs. NIKKEI225	0.061*** (0.011)	0.280* (0.161)	1.943*** (0.504)	-9304.1	18614.3	18633.2
S&P500 vs. S&P/TSX	0.031*** (0.004)	0.942*** (0.011)	1.001*** (0.269)	-9090.1	18186.1	18205.1
DAX30 vs. FTSE	0.058*** (0.005)	0.894*** (0.011)	5.123*** (1.333)	-7949.3	15904.6	15923.7
DAX30 vs. CAC40	0.058*** (0.004)	0.820*** (0.022)	3.799*** (0.576)	-7079.1	14164.1	14183.1
DAX30 vs. FTSE MIB	0.077*** (0.005)	0.823*** (0.013)	2.544*** (0.516)	-8479.3	16964.6	16983.7
DAX30 vs. NIKKEI225	0.008** (0.004)	0.951*** (0.044)	1.029** (0.500)	-9548.8	19103.6	19122.5
DAX30 vs. S&P/TSX	0.013*** (0.003)	0.975*** (0.011)	1.055** (0.420)	-9810.9	19640.1	19666.9
FTSE vs. CAC40	0.066*** (0.005)	0.901*** (0.011)	1.428*** (0.432)	-8990.7	17987.5	18006.5
FTSE vs. FTSE MIB	0.052*** (0.006)	0.913*** (0.012)	1.067*** (0.034)	-9339.5	18685.1	18704.1
FTSE vs. NIKKEI225	0.011*** (0.004)	0.958*** (0.025)	1.001* (0.593)	-9283.9	18573.9	18592.8
FTSE vs. S&P/TSX	0.014*** (0.004)	0.970*** (0.011)	1.196* (0.638)	-9425.8	18857.7	18876.8
CAC40 vs. FTSE MIB	0.054*** (0.004)	0.914*** (0.010)	1.041*** (0.270)	-7880.6	15767.3	15786.3
CAC40 vs. NIKKEI225	0.010** (0.004)	0.955*** (0.031)	1.030** (0.422)	-9590.1	19186.1	19205.1
CAC40 vs. S&P/TSX	0.018*** (0.005)	0.940*** (0.025)	1.314*** (0.377)	-9932.7	19871.5	19890.5
FTSE MIB vs. NIKKEI225	0.008** (0.004)	0.942*** (0.063)	1.042*** (0.539)	-9528.3	19062.8	19081.7

Continued on next page

<i>Dcc-Midas Parameters</i>	<i>a</i>	<i>b</i>	ω	<i>LL</i>	<i>AIC</i>	<i>BIC</i>
FTSE MIB vs. S&P/TSX	0.016*** (0.005)	0.972*** (0.007)	1.035** (0.510)	-8815.1	17626.1	17635.1
NIKKEI225 vs. S&P/TSX	0.016** (0.004)	0.968*** (0.010)	1.021*** (0.485)	-9381.9	18770.1	18788.8
BOVESPA vs. RTS	0.022*** (0.007)	0.933*** (0.040)	3.466*** (1.160)	-9172.8	18351.6	18370.5
BOVESPA vs. NIFTY500	0.008** (0.003)	0.980*** (0.014)	1.001*** (0.647)	-9307.2	18620.6	18639.4
BOVESPA vs. SHANGHAI	0.012** (0.001)	0.894*** (0.156)	3.138** (1.500)	-7955.3	15916.7	15935.5
BOVESPA vs. FTSE/JSE	0.018* (0.003)	0.743*** (0.266)	5.386*** (1.435)	-9568.2	19142.4	19161.3
BOVESPA vs. BIST100	0.011*** (0.004)	0.968*** (0.019)	1.504* (0.816)	-9637.1	19280.1	19298.9
RTS vs. NIFTY500	0.025*** (0.006)	0.925*** (0.031)	3.160** (1.295)	-8841.6	17689.3	17708.1
RTS vs. SHANGHAI	0.024*** (0.007)	0.894*** (0.047)	1.969*** (0.838)	-9398.6	18803.2	18822.1
RTS vs. FTSE/JSE	0.035*** (0.006)	0.934*** (0.019)	3.891*** (1.450)	-9231.4	18468.9	18487.8
RTS vs. BIST100	0.034*** (0.004)	0.944*** (0.009)	1.016*** (0.307)	-9933.1	19872.2	19891.1
NIFTY500 vs. SHANGHAI	0.020** (0.008)	0.900*** (0.062)	1.292*** (0.551)	-8993.8	17993.7	18012.5
NIFTY500 vs. FTSE/JSE	0.019*** (0.006)	0.937*** (0.029)	2.130** (0.832)	-9379.5	18765.1	18783.9
NIFTY500 vs. BIST100	0.015*** (0.004)	0.967*** (0.015)	1.304** (0.608)	-8854.1	17714.2	17733.1
SHANGHAI vs. FTSE/JSE	0.010* (0.007)	0.922*** (0.093)	1.190** (0.564)	-9645.3	19296.7	19315.5
SHANGHAI vs. BIST100	0.019*** (0.009)	0.824*** (0.140)	1.001*** (0.359)	-9350.1	18706.1	18724.9
FTSE/JSE vs. BIST100	0.026*** (0.005)	0.958*** (0.011)	1.062* (0.606)	-9380.6	18767.4	18786.3
S&P500 vs. BOVESPA	0.032*** (0.004)	0.954*** (0.006)	1.001*** (0.383)	-8571.2	17148.4	17167.4
S&P500 vs. RTS	0.015* (0.008)	0.907*** (0.109)	6.086*** (1.727)	-8925.4	17856.9	17875.8
S&P500 vs. NIFTY500	0.015** (0.007)	0.919*** (0.057)	1.001*** (0.446)	-9034.2	18074.4	18093.3

Continued on next page

<i>Dcc-Midas</i> <i>Parameters</i>	<i>a</i>	<i>b</i>	ω	<i>LL</i>	<i>AIC</i>	<i>BIC</i>
S&P500 vs. SHANGHAI	0.014** (0.006)	0.941*** (0.041)	2.060* (0.855)	-8318.7	16643.6	16662.4
S&P500 vs. FTSE/JSE	0.011* (0.005)	0.943*** (0.062)	7.214*** (2.482)	-8364.4	16734.8	16753.7
S&P500 vs. BIST100	0.006* (0.003)	0.966*** (0.026)	1.520* (0.724)	-9888.9	19783.9	19802.8
DAX30 vs. BOVESPA	0.018*** (0.003)	0.963*** (0.008)	2.010* (0.800)	-8537.3	17080.7	17099.6
DAX30 vs. RTS	0.035*** (0.007)	0.914*** (0.024)	4.76*** (1.252)	-9886.5	19779.1	19798.2
DAX30 vs. NIFTY500	0.011*** (0.003)	0.973*** (0.012)	1.030** (0.290)	-8443.1	16892.1	16911.1
DAX30 vs. SHANGHAI	0.006* (0.003)	0.976*** (0.027)	1.001* (0.580)	-8939.9	17885.8	17904.7
DAX30 vs. FTSE/JSE	0.030*** (0.005)	0.951*** (0.011)	1.497* (0.875)	-8813.9	17633.9	17652.9
DAX30 vs. BIST100	0.021*** (0.003)	0.968*** (0.007)	1.140* (0.530)	-8802.5	17611.2	17630.1
FTSE vs. BOVESPA	0.013*** (0.004)	0.953*** (0.029)	4.451*** (1.218)	-9744.5	19495.2	19514.1
FTSE vs. RTS	0.032*** (0.004)	0.932*** (0.015)	3.727*** (1.008)	-9637.2	19280.4	19299.4
FTSE vs. NIFTY500	0.014*** (0.004)	0.956*** (0.023)	1.065*** (0.048)	-9622.7	19251.5	19270.4
FTSE vs. SHANGHAI	0.007* (0.005)	0.938*** (0.101)	1.658* (0.971)	-8977.7	17961.5	17980.4
FTSE vs. FTSE/JSE	0.033*** (0.004)	0.951*** (0.009)	1.672* (0.970)	-8787.2	17580.4	17599.4
FTSE vs. BIST100	0.022*** (0.004)	0.962*** (0.010)	3.340* (1.896)	-8117.1	16240.4	16259.3
CAC40 vs. BOVESPA	0.018*** (0.003)	0.969*** (0.008)	1.070* (0.618)	-9934.7	19867.1	19886.2
CAC40 vs. RTS	0.043*** (0.007)	0.900*** (0.025)	3.219*** (0.899)	-9824.3	19654.6	19673.5
CAC40 vs. NIFTY500	0.016*** (0.005)	0.950*** (0.024)	1.214** (0.619)	-9835.9	19678.1	19696.9
CAC40 vs. SHANGHAI	0.008* (0.005)	0.951*** (0.075)	1.806* (0.967)	-9865.1	19736.1	19755.1
CAC40 vs. FTSE/JSE	0.029*** (0.005)	0.954*** (0.010)	1.003* (0.605)	-9555.6	19117.3	19136.3

Continued on next page

<i>Dcc-Midas</i> <i>Parameters</i>	<i>a</i>	<i>b</i>	ω	<i>LL</i>	<i>AIC</i>	<i>BIC</i>
CAC40 vs. BIST100	0.020*** (0.003)	0.971*** (0.006)	1.001* (0.640)	-9505.7	19017.6	19036.5
FTSE MIB vs. BOVESPA	0.016*** (0.003)	0.977*** (0.006)	1.001** (0.140)	-9857.1	19720.1	19739.1
FTSE MIB vs. RTS	0.037*** (0.007)	0.897*** (0.027)	2.108*** (0.588)	-9838.7	19683.5	19702.4
FTSE MIB vs. NIFTY500	0.015*** (0.004)	0.950*** (0.024)	1.001*** (0.344)	-9826.6	19659.2	19678.2
FTSE MIB vs. SHANGHAI	0.006* (0.004)	0.941*** (0.135)	1.150* (0.624)	-9014.6	18035.4	18054.2
FTSE MIB vs. FTSE/JSE	0.034*** (0.006)	0.938*** (0.016)	3.922* (1.380)	-8992.6	17991.3	18010.3
FTSE MIB vs. BIST100	0.021*** (0.003)	0.970*** (0.007)	2.021** (0.937)	-8844.5	17695.1	17714.1
NIKKEI225 vs. BOVESPA	0.011** (0.004)	0.959*** (0.034)	2.533* (1.305)	-8765.9	17537.9	17556.7
NIKKEI225 vs. RTS	0.013*** (0.004)	0.969*** (0.014)	1.051*** (0.095)	-9495.9	18997.9	19016.7
NIKKEI225 vs. NIFTY500	0.021*** (0.006)	0.931*** (0.030)	1.021*** (0.384)	-9326.3	18658.6	18677.4
NIKKEI225 vs. SHANGHAI	0.013*** (0.004)	0.974*** (0.015)	1.110** (0.192)	-9409.4	18824.9	18843.7
NIKKEI225 vs. FTSE/JSE	0.009** (0.004)	0.967*** (0.022)	1.001* (0.546)	-8558.2	17122.5	17141.4
NIKKEI225 vs. BIST100	0.024*** (0.008)	0.897*** (0.057)	2.768*** (0.862)	-9422.7	18851.6	18870.4
S&P/TSX vs. BOVESPA	0.037*** (0.007)	0.910*** (0.021)	1.042*** (0.039)	-9503.7	19013.5	19032.4
S&P/TSX vs. RTS	0.020*** (0.006)	0.934*** (0.044)	3.634*** (0.958)	-9853.6	19713.3	19732.2
S&P/TSX vs. NIFTY500	0.013** (0.005)	0.951*** (0.030)	1.121* (0.608)	-9398.1	18802.2	18821.1
S&P/TSX vs. SHANGHAI	0.014** (0.005)	0.959*** (0.021)	1.020* (0.573)	-9592.6	19191.4	19210.2
S&P/TSX vs. FTSE/JSE	0.015** (0.007)	0.929*** (0.056)	1.690*** (0.655)	-9953.4	19912.8	19931.8
S&P/TSX vs. BIST100	0.014*** (0.004)	0.967*** (0.015)	1.001* (0.572)	-9579.8	19165.8	19184.7

Notes: The numbers in the parentheses are standard errors. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. LL is the logarithmic likelihood, AIC is the Akaike information criterion and BIC is the Bayesian information criterion.

Table B.2. Parameter estimates of the DCC-MIDAS models based on the GARCH-MIDAS model with fixed window realized volatility for all country pairs.

<i>Dec-Midas</i>	<i>a</i>	<i>b</i>	ω	<i>LL</i>	<i>AIC</i>	<i>BIC</i>
<i>Parameters</i>						
S&P500 vs. DAX30	0.018*** (0.002)	0.966*** (0.005)	2.056*** (0.786)	-8489.5	16985.1	17004.1
S&P500 vs. FTSE	0.021*** (0.001)	0.939*** (0.004)	2.201*** (0.201)	-9097.2	18200.5	18219.5
S&P500 vs. CAC40	0.015*** (0.002)	0.976*** (0.003)	1.502* (0.788)	-8664.1	17334.2	17353.2
S&P500 vs. FTSE MIB	0.011*** (0.002)	0.981*** (0.004)	1.155* (0.765)	-9352.9	18711.9	18730.9
S&P500 vs. NIKKEI225	0.063*** (0.011)	0.280* (0.153)	1.868*** (0.505)	-9543.8	19093.7	19112.6
S&P500 vs. S&P/TSX	0.028*** (0.004)	0.951*** (0.009)	1.051*** (0.057)	-9168.4	18342.8	18361.8
DAX30 vs. FTSE	0.053*** (0.004)	0.915*** (0.008)	1.062*** (0.045)	-9156.5	18319.1	18338.1
DAX30 vs. CAC40	0.063*** (0.004)	0.756*** (0.033)	3.790*** (0.488)	-7084.1	14174.1	14193.2
DAX30 vs. FTSE MIB	0.076*** (0.005)	0.837*** (0.011)	1.021*** (0.022)	-8491.7	16989.6	17008.6
DAX30 vs. NIKKEI225	0.008* (0.004)	0.946*** (0.054)	1.001*** (0.107)	-9549.4	19105.1	19123.9
DAX30 vs. S&P/TSX	0.014*** (0.004)	0.967*** (0.015)	2.755** (1.395)	-9310.9	18627.9	18646.9
FTSE vs. CAC40	0.065*** (0.005)	0.905*** (0.009)	1.038*** (0.143)	-8990.2	17986.5	18005.6
FTSE vs. FTSE MIB	0.053*** (0.006)	0.911*** (0.012)	1.015*** (0.075)	-9344.4	18695.1	18714.1
FTSE vs. NIKKEI225	0.010*** (0.003)	0.960*** (0.022)	1.001*** (0.183)	-9053.2	18112.5	18131.4
FTSE vs. S&P/TSX	0.014*** (0.003)	0.971*** (0.010)	1.021*** (0.155)	-9425.1	18856.2	18875.2
CAC40 vs. FTSE MIB	0.055*** (0.004)	0.912*** (0.010)	1.081*** (0.058)	-7886.7	15779.4	15798.5
CAC40 vs. NIKKEI225	0.011** (0.004)	0.956*** (0.029)	1.033*** (0.123)	-9592.1	19190.1	19208.9
CAC40 vs. S&P/TSX	0.013*** (0.003)	0.972*** (0.012)	1.917* (1.046)	-9380.1	18766.2	18785.2
FTSE MIB vs. NIKKEI225	0.007** (0.003)	0.969*** (0.025)	1.052*** (0.200)	-8958.1	17922.1	17941.1

Continued on next page

<i>Dcc-Midas Parameters</i>	<i>a</i>	<i>b</i>	ω	<i>LL</i>	<i>AIC</i>	<i>BIC</i>
FTSE MIB vs. S&P/TSX	0.017*** (0.003)	0.972*** (0.007)	1.037** (0.520)	-8825.1	17656.1	17675.1
NIKKEI225 vs. S&P/TSX	0.017** (0.004)	0.968*** (0.008)	1.001*** (0.115)	-9534.2	19074.4	19093.3
BOVESPA vs. RTS	0.011*** (0.003)	0.983*** (0.006)	1.041*** (0.349)	-9036.1	18078.3	18097.1
BOVESPA vs. NIFTY500	0.008** (0.003)	0.980*** (0.013)	1.001*** (0.188)	-9306.7	18619.4	18638.3
BOVESPA vs. SHANGHAI	0.012** (0.001)	0.901*** (0.140)	3.071** (1.479)	-7920.5	15847.1	15865.8
BOVESPA vs. FTSE/JSE	0.009*** (0.002)	0.986*** (0.004)	1.012*** (0.305)	-8895.6	17797.3	17816.2
BOVESPA vs. BIST100	0.012*** (0.004)	0.968*** (0.017)	1.283* (0.737)	-9636.7	19279.4	19298.3
RTS vs. NIFTY500	0.023*** (0.006)	0.930*** (0.030)	2.170*** (0.828)	-9455.1	18916.3	18935.2
RTS vs. SHANGHAI	0.025*** (0.007)	0.902*** (0.038)	1.001*** (0.063)	-9399.4	18804.8	18823.7
RTS vs. FTSE/JSE	0.029*** (0.005)	0.952*** (0.012)	1.484** (0.644)	-9619.2	19244.6	19263.4
RTS vs. BIST100	0.035*** (0.004)	0.940*** (0.009)	1.015*** (0.049)	-9935.3	19876.7	19895.6
NIFTY500 vs. SHANGHAI	0.022** (0.009)	0.876*** (0.073)	1.090*** (0.411)	-9141.8	18289.7	18308.5
NIFTY500 vs. FTSE/JSE	0.017*** (0.005)	0.957*** (0.017)	1.022*** (0.125)	-9385.5	18777.1	18796.1
NIFTY500 vs. BIST100	0.016*** (0.004)	0.967*** (0.014)	1.179** (0.525)	-8845.9	17697.9	17716.7
SHANGHAI vs. FTSE/JSE	0.012* (0.007)	0.923*** (0.079)	1.080*** (0.088)	-9678.3	19362.6	19381.5
SHANGHAI vs. BIST100	0.019*** (0.009)	0.828*** (0.135)	1.001*** (0.072)	-9353.7	18713.5	18732.4
FTSE/JSE vs. BIST100	0.027*** (0.005)	0.957*** (0.011)	1.320*** (0.167)	-9321.3	18648.6	18667.5
S&P500 vs. BOVESPA	0.032*** (0.004)	0.955*** (0.006)	1.701** (0.138)	-8565.3	17136.6	17155.5
S&P500 vs. RTS	0.014* (0.007)	0.908*** (0.086)	7.481*** (2.128)	-8481.9	16969.8	16988.7
S&P500 vs. NIFTY500	0.014** (0.007)	0.920*** (0.059)	1.008*** (0.130)	-9030.1	18066.1	18084.9

Continued on next page

<i>Dcc-Midas</i> <i>Parameters</i>	<i>a</i>	<i>b</i>	ω	<i>LL</i>	<i>AIC</i>	<i>BIC</i>
S&P500 vs. SHANGHAI	0.015** (0.006)	0.947*** (0.029)	1.001*** (0.201)	-8491.2	16988.1	17006.9
S&P500 vs. FTSE/JSE	0.011* (0.006)	0.944*** (0.062)	5.989*** (2.053)	-8474.1	16954.2	16973.1
S&P500 vs. BIST100	0.005** (0.002)	0.981*** (0.008)	1.201** (0.424)	-9059.7	19125.5	19144.4
DAX30 vs. BOVESPA	0.018*** (0.003)	0.972*** (0.008)	1.091* (0.155)	-8537.9	17081.9	17100.8
DAX30 vs. RTS	0.031*** (0.004)	0.945*** (0.011)	1.002* (0.041)	-9756.1	19518.1	19537.2
DAX30 vs. NIFTY500	0.011*** (0.003)	0.976*** (0.008)	1.032*** (0.299)	-8462.1	16930.2	16949.2
DAX30 vs. SHANGHAI	0.004** (0.003)	0.988*** (0.012)	1.001** (0.376)	-8940.1	17886.2	17904.9
DAX30 vs. FTSE/JSE	0.030*** (0.005)	0.949*** (0.012)	1.796* (1.064)	-8814.7	17635.5	17654.5
DAX30 vs. BIST100	0.022*** (0.003)	0.968*** (0.007)	1.141* (0.533)	-8804.3	17614.7	17633.7
FTSE vs. BOVESPA	0.013** (0.003)	0.978*** (0.006)	1.001*** (0.165)	-9746.9	19499.4	19518.8
FTSE vs. RTS	0.033*** (0.004)	0.930*** (0.015)	3.341*** (0.898)	-9646.5	19299.1	19318.1
FTSE vs. NIFTY500	0.013*** (0.004)	0.960*** (0.021)	1.020*** (0.096)	-9687.4	19380.9	19399.9
FTSE vs. SHANGHAI	0.006* (0.005)	0.956*** (0.059)	1.001*** (0.156)	-8502.2	17010.5	17029.3
FTSE vs. FTSE/JSE	0.035*** (0.005)	0.945*** (0.012)	2.474* (1.359)	-8897.8	17801.8	17820.8
FTSE vs. BIST100	0.024*** (0.004)	0.960*** (0.010)	2.943* (1.764)	-8335.9	16678.1	16697.2
CAC40 vs. BOVESPA	0.017*** (0.003)	0.973*** (0.006)	1.001*** (0.126)	-9935.7	19877.5	19896.5
CAC40 vs. RTS	0.044*** (0.007)	0.901*** (0.023)	3.045*** (0.808)	-9826.3	19658.7	19677.6
CAC40 vs. NIFTY500	0.014*** (0.005)	0.951*** (0.028)	1.614** (0.764)	-9328.3	18662.8	18681.7
CAC40 vs. SHANGHAI	0.007* (0.005)	0.957*** (0.050)	1.012*** (0.085)	-9970.8	19947.7	19966.6
CAC40 vs. FTSE/JSE	0.029*** (0.005)	0.953*** (0.010)	1.103*** (0.155)	-9556.4	19118.8	19137.9

Continued on next page

<i>Dcc-Midas</i> <i>Parameters</i>	<i>a</i>	<i>b</i>	ω	<i>LL</i>	<i>AIC</i>	<i>BIC</i>
CAC40 vs. BIST100	0.021*** (0.003)	0.969*** (0.006)	1.008*** (0.199)	-9849.3	19704.6	19723.5
FTSE MIB vs. BOVESPA	0.017*** (0.003)	0.975*** (0.007)	1.001*** (0.146)	-9956.7	19712.5	19763.4
FTSE MIB vs. RTS	0.036*** (0.007)	0.906*** (0.024)	1.783*** (0.530)	-9843.1	19692.3	19711.2
FTSE MIB vs. NIFTY500	0.014*** (0.004)	0.953*** (0.023)	1.011** (0.076)	-9827.3	19660.5	19679.5
FTSE MIB vs. SHANGHAI	0.006* (0.004)	0.929*** (0.121)	1.321*** (0.114)	-9250.1	18506.3	18525.2
FTSE MIB vs. FTSE/JSE	0.031*** (0.005)	0.952*** (0.009)	1.188*** (0.194)	-9165.5	18337.1	18356.1
FTSE MIB vs. BIST100	0.020** (0.003)	0.972*** (0.006)	1.001*** (0.137)	-9891.2	19978.1	19990.9
NIKKEI225 vs. BOVESPA	0.011*** (0.003)	0.969*** (0.015)	1.231*** (0.131)	-8937.9	17882.2	17900.8
NIKKEI225 vs. RTS	0.013*** (0.004)	0.969*** (0.014)	1.001** (0.095)	-9495.9	18997.9	19016.7
NIKKEI225 vs. NIFTY500	0.022*** (0.006)	0.933*** (0.027)	1.321*** (0.236)	-9377.9	18762.1	18780.8
NIKKEI225 vs. SHANGHAI	0.012*** (0.004)	0.977*** (0.013)	1.120*** (0.182)	-9340.6	18687.2	18706.1
NIKKEI225 vs. FTSE/JSE	0.008** (0.004)	0.967*** (0.023)	1.001*** (0.130)	-8698.2	17402.5	17421.3
NIKKEI225 vs. BIST100	0.017*** (0.005)	0.954*** (0.017)	1.140*** (0.089)	-9888.1	19782.2	19801.1
S&P/TSX vs. BOVESPA	0.037*** (0.007)	0.910*** (0.021)	1.001*** (0.039)	-9503.7	19013.5	19032.4
S&P/TSX vs. RTS	0.012*** (0.002)	0.975*** (0.007)	1.101* (0.463)	-8773.1	17552.4	17571.3
S&P/TSX vs. NIFTY500	0.013** (0.005)	0.952*** (0.029)	1.201*** (0.145)	-9449.2	18904.6	18923.5
S&P/TSX vs. SHANGHAI	0.016*** (0.005)	0.957*** (0.021)	1.024*** (0.106)	-9680.4	19366.4	19385.2
S&P/TSX vs. FTSE/JSE	0.016*** (0.006)	0.939*** (0.033)	1.020*** (0.092)	-9580.3	19166.8	19185.7
S&P/TSX vs. BIST100	0.015*** (0.004)	0.967*** (0.014)	1.001*** (0.149)	-9578.7	19163.6	19182.5

Notes: The numbers in the parentheses are standard errors. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. LL is the logarithmic likelihood, AIC is the Akaike information criterion and BIC is the Bayesian information criterion.



AIMS Press

© 2021 the Author(s), licensee AIMS Press. This is an open access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>)