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Do Commodity Return Shocks Affect Financial Sector Index Returns Asymmetrically? The Case of Euro Area

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Abstract

This paper analyzes the effects of commodity return shocks on financial sector index returns. In the last decades, because of their survival importance in economic system, commodity prices and their effects have been investigated thoroughly by policy makers and academicians. Many of these studies try to explore the effects of commodity shocks on stock markets. But in recent years, it is seen that, commodity price changes can affect the financial markets and in private, sectors differently. Therefore, we aim to determine if commodity return shocks cause asymmetric effects on financial sector index returns or not. For this purpose, in the study, the effects of shocks that occur in gold, oil and silver returns on financial sector returns of European countries will be analyzed via asymmetric causality test developed by Hatemi-J (2012). Empirical results show that commodity return shocks have asymmetric effects on European financial sector index returns in most cases.

Keywords: Commodity prices, sectoral stock indices, asymmetric effect, portfolio management.
JEL Classification: C58, G11, G15

I. Introduction

Changes in commodity prices affect all participants in the economy directly or indirectly. Especially, in industrialized economies commodity prices shape the economic and political developments (Huang, et al., 1996). The main reasons of these effects are the usage of commodities as fundamental inputs in too many sectors and their indirect effects on too many inputs that are used in production process (Chong and Miffre, 2010). On the other hand, commodities and commodity based financial instruments are alternative investment vehicles to traditional instruments like stocks and bonds. Therefore, it is needed to follow the changes in commodity returns closely, to analyze the possible effects correctly and to develop suitable policies for relevant economic units.

Changes in commodity prices cause important changes in balance of payments and affect international capital flows. Increases in commodity prices cause deficits in balance of payments of importer countries while increasing export revenues of exporter countries. Also, as it is indicated in the study of Papapetrou (2001) there is a significant relationship between oil prices and economic activity and employment, more particularly in industrialized countries. On the other hand, increases in prices cause increase in inflation by increasing production costs of firms. From the viewpoint of investors, there are two dimensions of the topic. Firstly, as we mentioned above they are investment vehicles for investors and they increasingly become part of asset portfolio allocation (Choi and Hammoudeh, 2010). Secondly, changes that occur in commodity returns affect the return of too many financial assets, notably stocks. Due to the usage amount in production process, commodity price changes affect the costs, thus profitability of the firm and value of firm. In other words, commodity prices have effects on firm value through real activity (Miller and Ratti, 2009). Such that, in some periods, commodity prices may exhibit higher volatility in comparison to exchange rates and interest rates and the effects of commodity price changes on firm value may be higher (Bartram, 2005). So, stock investors also should fallow the changes in commodity returns and consider the possible effects of these changes in investment decisions.

Especially in last decade, important changes have occurred in commodity prices. These changes caused policymakers and academicians to focus on the effects of these changes on economy, especially on stock markets. Park and Ratti (2008) and Sadorsky (1999) also investigated the relationships between oil price shocks and stock markets. They both proved that oil price shocks have statistically significant impact on real stock returns in USA and most of the European countries. Miller and Ratti (2009) also proved that six of OECD stock market indices respond negatively to increases in the oil price shocks in the long run. Mensi, et al. (2013) examined return and volatility spillovers between stock and commodity markets including oil and gold markets and they found the evidence of transmissions between stock markets and oil and gold markets. Similarly, Creti, et al. (2013) analyzed the linkages between commodity and stock markets. DCC-GARCH model results showed that the correlations between commodity and stock markets are highly volatile.

Aloui and Jammazi (2009) determined the relationships between oil price shocks and stock markets of UK, France and Japan stock markets. The empirical results showed that rises in oil price has a significant role in determining the volatility of stock returns. Filis, et al. (2011) also analyzed the relationships between oil prices and stock markets. The results of DCC-GARCH model showed that oil price shocks have negative effects on stock market of both oil-importing and oil-exporting countries. Unlike the majority of the literature on the relationships between oil price shocks and stock returns Apergis and Miller (2009) indicated that international stock market returns do not respond in a large way to oil market shocks, the empirical results showed that effects of oil price shocks are small in magnitude. By using DCC-GARCH models Choi and Hammoudeh (2010) proved that the correlations between S&P 500 and commodities decrease since 2003. Gang-Cong, et al. (2008) analyzed the effects of oil price shocks on Chinese stock market. The results of multivariate vector auto-regression methodology showed that oil price shocks do not have significant impact on the real stock returns of most Chinese stock market indexes, except for manufacturing index and some oil companies. Similarly, Chen, et al. (1986) indicated that there is no significant effect of oil price changes on stock returns.

It is seen when the existing empirical literature is reviewed that there are too many studies in the literature that analyze the effects of commodity price changes on stock markets. But in recent years, it is realized that, changes in commodity prices have different effects on financial markets and sectors. In other words, positive and negative shocks in commodity prices can affect markets or sectors asymmetrically. For this reason, it is very important for portfolio and risk management to consider the asymmetric effects on sectors caused by changes in commodity prices. This study analyzes the asymmetric effects of commodity return shocks on returns of 17 European financial sector indexes. We argue that it is important to consider the effects of commodity return shocks on stock returns in order to better identify effects that may be asymmetric and sector specific.

The remainder of this paper is organized as follows. In the next section the variables, the data and the methodology of the study are presented. In Section III, summary statistics of the series and empirical results, in other words, the effects of commodity price shocks on the stock market indexes are given. Section IV concludes.

II. Methodology and Data

In the study we used asymmetric causality test developed by Hatemi-J (2012) to analyze the asymmetric relationships between commodity shocks and financial sector indexes of European countries. In traditional Granger causality test (1969), it is tested that if one of the

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variables provide useful information in forecasting the future value of the other one or not. But, traditional Granger test and many of the causality tests (Sims, 1972; Hsiao, 1981; Toda and Yamamoto, 1995) that have been widely used in the literature assume that the effects of positive and negative shocks are in symmetric. However, the results of these test may be misleading because of the changing financial forms, different perception and expectations of the investors and asymmetric information etc.

Granger and Yoon (2002) separated the data into both cumulative positive and negative changes to investigate the long-run relationships by stating that the relationships between positive and positive shocks can be different from the relationships between the variables. Then, Hatemi-J (2012) introduced asymmetric causality test based on the approach of Granger and Yoon (2002).

Assume an analysis of causal relationship between two integrated variables y_{1t} and y_{2t} that each is defined as a following random walk process:

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{1,0} + \sum_{i=1}^{t} \varepsilon_{1i} \quad (1)$$
$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{2,0} + \sum_{i=1}^{t} \varepsilon_{2i} \quad (2)$$

where t=1,2,…T, $y_{1,0}$ and $y_{2,0}$ are the initial values y_{1t} and y_{2t} respectively, and ε_{1i} and ε_{2i} are assumed to be the white noise error terms.

If the positive and negative shocks are shown as at equation (3):

$$\varepsilon_{1i}^{+} = maks\ (\varepsilon_{1i}, 0) \qquad \varepsilon_{1i}^{-} = min\ (\varepsilon_{1i}, 0)$$
$$\varepsilon_{2i}^{+} = maks\ (\varepsilon_{2i}, 0) \qquad \varepsilon_{2i}^{-} = min\ (\varepsilon_{2i}, 0) \quad (3)$$

Therefore, one can express $\varepsilon_{1i} = \varepsilon_{1i}^{+} + \varepsilon_{1i}^{-}$ and $\varepsilon_{2t} = \varepsilon_{2i}^{+} + \varepsilon_{2i}^{-}$. Thus, the equations (1) and (2) can be written as follows:

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{1,0} + \sum_{i=1}^{t} \varepsilon_{1i}^{+} + \sum_{i=1}^{t} \varepsilon_{1i}^{-}$$
$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{2,0} + \sum_{i=1}^{t} \varepsilon_{2i}^{+} + \sum_{i=1}^{t} \varepsilon_{2i}^{-} \quad (4)$$

The positive and negative shocks of each variable can be defined in a cumulative form as seen at equation (5);

$$y_{1i}^{+} = \sum_{i=1}^{t} \varepsilon_{1i}^{+} \qquad y_{1i}^{-} = \sum_{i=1}^{t} \varepsilon_{1i}^{-} \qquad y_{2i}^{+} = \sum_{i=1}^{t} \varepsilon_{2i}^{+} \qquad y_{2i}^{-} = \sum_{i=1}^{t} \varepsilon_{2i}^{-} \quad (5)$$

In Hatemi-J test, by assuming $y_t^{+} = (y_{1t}^{+} + y_{2t}^{+})$, casual relationships between components can be applied by using following vector autoregressive model of order p, VAR (p);

$$y_t^{+} = v + \emptyset_1 y_{t-1}^{+} + \cdots + p y_{t-p}^{+} + u_t^{+} \quad (6)$$

where $y_t^{+}$is the 2x1 vector of variables, v is the 2x1 vector of intercepts and $u_t^{+}$is a vector of error terms. The matrix ϕ_r is a 2x2 matrix of parameters for lag order r $r = (1, \ldots p)$

The null hypothesis that tests the non-causality ($H_0{:}\, C\beta = 0$) is tested by following Wald statistic;

$$Wald = (C\beta)'[C((Z'Z)^{-1} \otimes S_U)C']^{-1}(C\beta) \quad (7)$$

The existence of multivariate normality and multivariate ARCH effects between the variables affect the asymptotic distribution of Wald test. But in the method of Hatemi-J, obtaining the critical values by bootstrap simulations in order to overcome this problem is the superiority of the test. Therefore, to apply asymmetric causality test, firstly we used The Doornik and

Hansen (2008) test to check normality and Hacker and Hatemi-J (2005) test to detect ARCH effects.

We used weekly returns of gold (G), oil (O) and silver (S) and weekly financial sector index returns of Austria (A), Belgium (B), Denmark (DK), Finland (FIN), France (F), Germany (D), Greece (GR), Italy (I), Netherlands (N), Norway (N), Poland (PL), Portugal (P), Spain (E), Sweeden (SE), Switzerland (CH), Turkey (TR) and United Kingdom (GB). The data consists of 384 observations for each variable between 09.15.2008 - 01.20.2016 and was obtained from Datastream.

III. Empirical Results

In the study, before analyzing the asymmetric relationships between commodity returns and financial sector returns of European countries, descriptive statistics of the series were computed and displayed in Table I.

Table I. Descriptive Statistics

	Mean	Median	Max.	Min.	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	ADF
G	0.0014	0.0015	0.089	-0.080	0.024	-0.044	4.264	25.703*	-18.54*
O	-0.0031	-0.0004	0.243	-0.357	0.056	-0.933	9.965	831.99*	-21.72*
S	0.0011	0.0024	0.123	-0.264	0.043	-0.982	8.969	631.76*	-18.72*
A	-0.0010	0.0021	0.157	-0.488	0.052	-2.536	23.842	7362.11*	-19.24*
B	-0.0009	0.0028	0.165	-0.333	0.048	-1.747	13.591	1990.15*	-18.63*
CH	-0.0006	0.0019	0.233	-0.367	0.045	-1.436	17.673	3576.76*	-24.09*
D	0.00001	0.0022	0.177	-0.296	0.042	-0.810	10.951	1053.38*	-21.16*
DK	0.0008	0.0035	0.128	-0.295	0.040	-1.694	13.299	1880.76*	-21.39*
E	-0.0017	0.0011	0.159	-0.243	0.052	-0.578	5.355	110.09*	-21.74*
F	-0.0004	0.0043	0.190	-0.246	0.053	-0.501	6.469	208.61*	-20.81*
FIN	0.0022	0.0042	0.136	-0.178	0.037	-0.749	6.491	230.83*	-22.96*
GB	-0.0006	0.0009	0.167	-0.284	0.042	-1.196	11.380	1214.98*	-20.51*
GR	-0.0146	-0.0091	0.463	-0.693	0.106	-0.579	9.161	628.81*	-20.34*
I	-0.0019	0.0017	0.127	-0.236	0.052	-0.746	4.948	96.38*	-20.16*
N	0.0012	0.0028	0.215	-0.330	0.047	-1.002	11.933	1341.03*	-22.38*
NL	-0.0014	0.0005	0.215	-0.517	0.068	-1.622	14.280	2204.32*	-19.75*
P	-0.0073	-0.0048	0.184	-0.284	0.066	-0.394	4.413	41.86*	-18.43*
PL	-0.0006	0.0010	0.179	-0.189	0.037	-0.744	8.856	584.07*	-9.834*
SE	0.0015	0.0047	0.160	-0.295	0.040	-1.478	12.910	1711.02*	-21.81*
TR	0.0010	0.0028	0.197	-0.238	0.043	-0.214	6.863	241.65*	-20.03*

It is seen from Table I that skewness value of all series are negative. Also, high kurtosis values indicate that big shocks are possible and series move away normal distribution. In order to check the stationarity of the series, we performed Augmented Dickey Fuller (ADF) unit root test and the results showed that all series are stationary. In the next step, unconditional correlations between commodity returns and financial sector returns of European countries were determined and results were presented in Table II. As it is seen from the table there is a negative correlation between gold return and financial sector returns of European countries. But, financial sector returns of European countries are positively correlated with oil and silver returns in low degrees.

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Table II. Unconditional Correlations

	GOLD	OIL	SILVER
A	-0.0876	0.2830	0.1303
B	-0.0887	0.2930	0.1464
CH	-0.0974	0.2867	0.1132
D	-0.1115	0.2935	0.1366
DK	-0.0530	0.2393	0.1074
E	-0.1500	0.2479	0.0654
F	-0.1081	0.3179	0.1170
FIN	-0.0678	0.3351	0.1663
GB	-0.0943	0.3570	0.1241
GR	-0.0601	0.1980	0.1042
I	-0.1540	0.2387	0.0980
N	-0.0665	0.3549	0.1680
NL	-0.0972	0.2832	0.1339
P	-0.1656	0.1847	0.0290
PL	-0.1090	0.3226	0.0798
SE	-0.0824	0.3319	0.1269
TR	-0.0463	0.1875	0.1283

The way of decreasing portfolio risk is to make diversification by including lowly correlated financial instruments to the portfolio. Unconditional correlation test results indicate low correlations between commodity returns and financial sector returns of European countries. Therefore, it can be said that investors who invest in European financial sector indexes or commodities can decrease portfolio risk by including the other one to the portfolio. However, when the commodity shocks that occur in the last decades are considered, it is thought that traditional econometric techniques can not reveal the asymmetric effects. In this context, in the next step, besides the traditional causality test, casual relationships between commodity returns and financial sector returns of European countries were analyzed via asymmetric causality test. Firstly, traditional causality tests were applied and results were shown in Table III.

Table III. The Results of Traditional Granger Causality Test

	Test Value		Test Value		Test Value
G = > A	0.705	O = > A	0.211	S = > A	0.284
G = > B	0.435	O = > B	0.101	S = > B	0.849
G = > CH	0.396	O = > CH	**0.063**	S = > CH	0.131
G = > D	0.598	O = > G	0.121	S = > G	0.268
G = > DK	0.201	O = > DK	0.235	S = > DK	0.203
G = > E	0.479	O = > E	**0.097**	S = > E	0.541
G = > F	0.323	O = > F	0.252	S = > F	0.556
G = > FIN	**0.019**	O = > FIN	0.617	S = > FIN	**0.001**
G = > GB	**0.009**	O = > GB	**0.007**	S = > GB	**0.042**
G = > GR	0.458	O = > GRE	0.239	S = > GRE	0.459
G = > I	0.573	O = > I	0.699	S = > I	0.561
G = > N	0.601	O = > N	**0.011**	S = > N	**0.068**
G = > NL	0.236	O = > NL	0.678	S = > NL	0.229
G = > P	0.241	O = > P	0.358	S = > P	0.289
G = > PL	0.149	O = > PL	**0.003**	S = > PL	**0.025**
G = > SE	0.528	O = > SE	0.716	S = > SE	0.725
G = > TR	0.111	O = > TR	0.966	S = > TR	0.119

Optimal VAR lag length is selected based on AIC information criteria.

The results of traditional Granger test show that there are significant casual relationships between gold return and financial sector returns of Finland and UK; oil return and financial sector returns of Norway, Poland, Spain, Switzerland and UK; silver return and financial sector returns of Finland, Norway, Poland and UK. In the next step, we will apply asymmetric causality test in order to determine the asymmetric effects of commodity shocks on financial sector index returns and to compare with the results of traditional causality test results. But before asymmetric causality test, we performed The Doornik and Hansen (2008) test to check normality and Hacker and Hatemi-J (2005) test to detect ARCH effects. Results which are given at Appendix II indicate that series are not normally distributed and have ARCH effects. Therefore, we used asymmetric causality test developed by Hatemi-J (2012) to analyze the casual relationships between each commodity returns and financial sector returns of European countries. Asymmetric causality test results and estimated casual parameters are given at Appendix I and summarized version of results of asymmetric causality test between gold return and financial sector returns of European countries are presented at Table IV.

Table IV. Results of Asymmetric Causality Test between Gold Return and Financial Sector Returns

	$Gold^+$	$Gold^-$		$Gold^+$	$Gold^-$		$Gold^+$	$Gold^-$
A^+	+	-	F^+	+	-	NL^+	-	-
A^-	+	+	F^-	+	+	NL^-	+	-
B^+	+	+	FIN^+	+	+	P^+	-	-
B^-	+	-	FIN^-	+	+	P^-	-	-
CH^+	+	+	GB^+	+	+	PL^+	-	+
CH^-	+	+	GB^-	+	+	PL^-	+	+
D^+	+	-	GR^+	-	-	SE^+	-	-
D^-	+	+	GR^-	-	-	SE^-	+	+
DK^+	+	+	I^+	+	-	TR^+	+	-
DK^-	+	+	I^-	+	+	TR^-	+	-
E^+	+	+	N^+	+	-			
E^-	+	+	N^-	+	-			

When the results of asymmetric causality test between gold returns and financial sector returns of European countries are investigated, it is seen that asymmetric causality test performs better to capture the relationships than to traditional Granger causality test. There are significant relationships between gold returns and financial sector returns of Denmark, Finland, Spain, Switzerland and UK in all asymmetric dimensions. But there is no asymmetric causality between gold returns and financial sector returns of Greece and Portugal. The results indicate that there are significant casual relationships between positive gold shocks and negative financial sector returns of all countries except Greece and Portugal. On the other hand, when the asymmetric causality parameters are examined, it is concluded that the effects of positive gold shocks on positive financial sector returns of Austria, Denmark, Finland, France, Germany, Spain, Switzerland and UK are greater than the effects of negative gold shocks.

Results of asymmetric causality test between oil return and financial sector returns of European countries are presented at Table V.

Table V. Results of Asymmetric Causality Test between Oil Return and Financial Sector Returns

	Oil $^{+}$	Oil $^{-}$		Oil $^{+}$	Oil $^{-}$		Oil $^{+}$	Oil $^{-}$
A $^{+}$	-	+	F $^{+}$	-	-	NL $^{+}$	-	-
A $^{-}$	-	-	F $^{-}$	+	-	NL $^{-}$	+	-
B $^{+}$	-	-	FIN $^{+}$	-	-	P $^{+}$	-	-
B $^{-}$	+	-	FIN $^{-}$	+	-	P $^{-}$	-	-
CH $^{+}$	+	+	GB $^{+}$	-	-	PL $^{+}$	+	-
CH $^{-}$	+	+	GB $^{-}$	+	-	PL $^{-}$	+	-
D $^{+}$	-	-	GR $^{+}$	-	-	SE $^{+}$	+	-
D $^{-}$	+	-	GR $^{-}$	-	-	SE $^{-}$	+	-
DK $^{+}$	-	-	I $^{+}$	-	-	TR $^{+}$	-	-
DK $^{-}$	-	-	I $^{-}$	+	-	TR $^{-}$	+	-
E $^{+}$	-	-	N $^{+}$	+	-			
E $^{-}$	+	+	N $^{-}$	+	-			

According to results of asymmetric causality test between oil returns and financial sector returns, there are significant relationships between oil return and financial sector return in all asymmetric dimensions just for Switzerland. There is no asymmetric causality between oil returns and financial sector returns of Denmark, Greece and Portugal. The results show that positive oil shocks affect negative financial sector returns of Belgium, Finland, France, Germany, Italy, Netherlands, Turkey and UK and all of the estimated causality parameters are negative. On the other hand, it is seen that the effects of positive oil shocks on positive financial sector returns of Switzerland is greater than the effects of negative oil shocks.

Results of asymmetric causality test between silver return and financial sector returns of European countries are displayed at Table VI.

Table VI. Results of Asymmetric Causality Test between Silver Return and Financial Sector Returns

	Silver $^{+}$	Silver $^{-}$		Silver $^{+}$	Silver $^{-}$		Silver $^{+}$	Silver $^{-}$
A $^{+}$	-	-	F $^{+}$	-	-	NL $^{+}$	-	-
A $^{-}$	-	-	F $^{-}$	+	-	NL $^{-}$	+	-
B $^{+}$	-	-	FIN $^{+}$	-	-	P $^{+}$	-	-
B $^{-}$	+	-	FIN $^{-}$	+	-	P $^{-}$	-	-
CH $^{+}$	-	-	GB $^{+}$	-	-	PL $^{+}$	+	-
CH $^{-}$	-	-	GB $^{-}$	+	-	PL $^{-}$	-	-
D $^{+}$	-	-	GR $^{+}$	-	-	SE $^{+}$	-	-
D $^{-}$	+	-	GR $^{-}$	-	-	SE $^{-}$	-	-
DK $^{+}$	-	-	I $^{+}$	-	-	TR $^{+}$	+	-
DK $^{-}$	+	-	I $^{-}$	-	-	TR $^{-}$	+	-
E $^{+}$	-	-	N $^{+}$	-	-			
E $^{-}$	+	-	N $^{-}$	+	-			

Table VI shows that there is no significant relationship between silver returns and financial sector returns of all countries for all asymmetric dimensions. There are significant causality relations between positive silver shocks and negative financial sector returns of Belgium, Denmark, Finland, France, Germany, Netherlands, Norway, Spain and UK. But, there is no significant causality between silver returns and financial sector returns of Austria, Greece, Italy, Portugal, Sweden and Switzerland. According to estimated causality parameters, positive silver shocks only cause decrease in financial sector returns of France and Germany.

IV. Conclusion

In this study we aimed to determine the effects of commodity shocks on financial sector returns of European countries. For this purpose we analyzed the relationships between gold, oil and silver returns and financial sector index returns by applying traditional Granger causality and asymmetric causality tests. Analyses showed that asymmetric causality test performs better to capture the relationships than to traditional Granger causality test.

Asymmetric causality tests indicate that financial sector returns of European countries have more asymmetric relationships with gold returns than to oil and silver returns. In this context, it can be concluded that gold and gold based financial instruments are better alternatives to financial sector indexes than to oil, silver, oil based and silver based financial instruments. Financial sector of Switzerland is the unique that is affected from gold and oil shocks in all asymmetric dimensions. On the other, there is no causality between commodity shocks and Greece and Portuguese financial sectors. So, investors who invest in financial sector indexes of these countries may invest in these commodities to diversify their portfolios.

Another important result of the study is estimated asymmetric parameters which indicate that investors react more to positive shocks than to negative ones. Thus, investors who are willing to invest in financial sector returns of European countries should fallow the commodity prices closely and consider the greater effects of positive shocks on indexes. On the other hand, in further studies it can be useful to analyze the volatility and time varying structure of the relationships between commodity return shocks and sectoral index returns for portfolio allocation decisions.

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Appendix I. Asymmetric Causality Test Results

	Wald Stat.	Critical bootstrap value			Significant Causal Parameter Value		Wald Stat.	Critical bootstrap value			Significant Causal Parameter Value
		1%	5%	10%				1%	5%	10%	
$G^{+} \neq> A^{+}$	**11.655**	12.829	8.408	6.602	0.138	$O^{-} \neq> GB^{+}$	0.436	11.832	6.483	4.929	
$G^{-} \neq> A^{-}$	**8.474**	13.248	9.913	7.962	0.11	$O^{+} \neq> GB^{-}$	**9.833**	11.15	6.946	4.912	-0.031
$G^{-} \neq> A^{+}$	0.986	10.461	6.48	4.976		$O^{+} \neq> GR^{+}$	0.539	10.548	6.824	4.792	
$G^{+} \neq> A^{-}$	**20.846**	11.989	6.289	4.572	-0.002	$O^{-} \neq> GR^{-}$	5.685	11.976	8.199	6.473	
$G^{+} \neq> B^{+}$	**6.846**	10.886	6.583	4.822	0.214	$O^{-} \neq> GR^{+}$	4.351	11.372	6.075	4.806	
$G^{-} \neq> B^{-}$	2.804	11.664	6.403	4.653		$O^{+} \neq> GR^{-}$	2.297	10.723	6.623	4.941	
$G^{-} \neq> B^{+}$	**6.02**	10.156	6.663	4.89	-0.195	$O^{+} \neq> I^{+}$	1.25	9.904	5.835	4.529	
$G^{+} \neq> B^{-}$	**14.541**	10.59	5.98	4.515	0.003	$O^{-} \neq> I^{-}$	2.387	9.84	6.031	4.534	
$G^{+} \neq> CH^{+}$	**7.589**	13.553	8.584	6.503	0.189	$O^{-} \neq> I^{+}$	2.31	10.738	6.356	4.528	
$G^{-} \neq> CH^{-}$	**14.393**	8.941	5.694	4.649	0.175	$O^{+} \neq> I^{-}$	**5.545**	10.123	6.283	4.558	-0.038
$G^{-} \neq> CH^{+}$	**5.329**	11.248	6.685	4.829	-0.179	$O^{+} \neq> N^{+}$	**21.443**	17.321	11.78	9.441	0.041
$G^{+} \neq> CH^{-}$	**9.352**	10.327	6.65	4.67	-0.001	$O^{-} \neq> N^{-}$	3.844	9.91	6.419	4.951	
$G^{+} \neq> D^{+}$	**8.456**	13.632	8.935	6.761	0.051	$O^{-} \neq> N^{+}$	0.216	11.433	5.671	4.378	
$G^{-} \neq> D^{-}$	**13.211**	10.758	6.688	4.993	0.028	$O^{+} \neq> N^{-}$	**13.075**	11.963	6.526	4.975	-0.016
$G^{-} \neq> D^{+}$	4.29	11.794	7.222	5.127		$O^{+} \neq> NL^{+}$	1.057	10.698	6.792	4.943	
$G^{+} \neq> D^{-}$	**15.184**	11.798	6.607	4.918	0.001	$O^{+} \neq> NL^{+}$	2.183	10.566	5.952	4.655	
$G^{+} \neq> DK^{+}$	**10.414**	13.376	8.234	6.777	0.235	$O^{-} \neq> NL^{-}$	2.267	11.815	6.673	4.812	
$G^{-} \neq> DK^{-}$	**10.008**	6.777	3.861	2.722	0.202	$O^{-} \neq> NL^{+}$	**7.286**	13.015	6.981	4.753	-0.016
$G^{-} \neq> DK^{+}$	**8.546**	10.663	6.324	4.772	-0.192	$O^{+} \neq> P^{+}$	2.425	11.896	6.068	4.627	
$G^{+} \neq> DK^{-}$	**13.652**	9.926	6.245	4.455	-0.031	$O^{-} \neq> P^{-}$	1.578	9.851	6.281	4.618	
$G^{+} \neq> E^{+}$	**18.703**	12.715	7.752	6.206	0.222	$O^{-} \neq> P^{+}$	0.775	10.68	6.161	4.646	
$G^{-} \neq> E^{-}$	**10.234**	11.64	8.162	6.464	0.013	$O^{+} \neq> P^{-}$	3.788	10.873	5.982	4.587	
$G^{-} \neq> E^{+}$	**5.833**	10.949	6.221	4.541	-0.154	$O^{+} \neq> PL^{+}$	**13.742**	16.044	11.669	9.582	-0.034
$G^{+} \neq> E^{-}$	**22.512**	10.31	5.94	4.516	-0.032	$O^{-} \neq> PL^{-}$	1.335	11.083	6.483	4.678	
$G^{+} \neq> F^{+}$	**10.083**	12.346	8.214	6.573	0.158	$O^{-} \neq> PL^{+}$	1.655	12.221	6.488	4.852	
$G^{-} \neq> F^{-}$	**7.967**	14.625	9.657	7.245	0.118	$O^{+} \neq> PL^{-}$	**11.964**	12.408	7.124	4.615	0.184
$G^{-} \neq> F^{+}$	3.549	9.941	6.64	4.939		$O^{+} \neq> SE^{+}$	**29.209**	21.479	17.315	14.692	0.019
$G^{+} \neq> F^{-}$	**22.07**	9.488	6.289	4.539	0.007	$O^{-} \neq> SE^{-}$	0.337	9.735	6.208	4.863	
$G^{+} \neq> FIN^{+}$	**7.687**	11.339	7.335	5.114	0.101	$O^{-} \neq> SE^{+}$	3.698	11.437	6.104	4.731	
$G^{-} \neq> FIN^{-}$	**6.488**	11.035	6.42	4.981	0.079	$O^{+} \neq> SE^{-}$	**11.987**	11.366	6.798	4.89	-0.004
$G^{-} \neq> FIN^{+}$	**6.024**	11.612	6.848	5.196	-0.095	$O^{+} \neq> TR^{+}$	3.686	10.655	6.41	4.811	

$G^{+} \neq > FIN^{-}$	**9.143**	10.115	6.119	4.683	0.004	$O^{-} \neq > TR^{-}$	2.275	10.855	6.587	4.854	
$G^{+} \neq > GB^{+}$	**11.725**	10.519	6.467	4.883	0.135	$O^{-} \neq > TR^{+}$	3.326	9.024	6.097	4.939	
$G^{-} \neq > GB^{-}$	**11.881**	9.86	6.253	4.618	0.117	$O^{+} \neq > TR^{-}$	**6.771**	10.265	6.641	4.773	-0.099
$G^{-} \neq > GB^{+}$	**5.329**	10.193	6.146	5.041	-0.137	$S^{+} \neq > A^{+}$	0.071	9.97	5.757	4.393	
$G^{+} \neq > GB^{-}$	**10.725**	9.502	6.478	4.997	0.004	$S^{-} \neq > A^{-}$	1.259	11.95	6.073	4.464	
$G^{+} \neq > GR^{+}$	3.156	11.235	7.951	6.312		$S^{-} \neq > A^{+}$	0.441	9.983	6.042	4.568	
$G^{-} \neq > GR^{-}$	1.717	12.108	8.056	6.311		$S^{+} \neq > A^{-}$	2.461	10.257	6.55	4.828	
$G^{-} \neq > GR^{+}$	2.949	10.811	6.238	4.672		$S^{+} \neq > B^{+}$	0.792	10.532	6.068	4.372	
$G^{+} \neq > GR^{-}$	0.57	10.644	6.22	4.892		$S^{-} \neq > B^{-}$	4.488	11.193	6.406	4.535	
$G^{+} \neq > I^{+}$	**12.229**	12.539	7.791	6.347	0.038	$S^{-} \neq > B^{+}$	1.619	10.638	6.604	4.813	
$G^{-} \neq > I^{-}$	**10.086**	10.135	6.42	4.472	-0.011	$S^{+} \neq > B^{-}$	**12.384**	10.723	6.009	4.412	-0.014
$G^{-} \neq > I^{+}$	3.03	9.851	6.208	4.808		$S^{+} \neq > CH^{+}$	2.035	10.789	5.834	4.251	
$G^{+} \neq > I^{-}$	**17.031**	11.205	5.997	4.595	-0.004	$S^{-} \neq > CH^{-}$	0.019	10.564	6.122	4.567	
$G^{+} \neq > N^{+}$	**12.305**	11.874	7.782	6.228	0.097	$S^{-} \neq > CH^{+}$	2.051	13.27	6.667	4.777	
$G^{-} \neq > N^{-}$	2.203	10.25	6.077	4.711		$S^{+} \neq > CH^{-}$	3.448	10.127	6.423	4.671	
$G^{-} \neq > N^{+}$	2.586	9.898	6.271	4.815		$S^{+} \neq > D^{+}$	0.88	11.635	6.87	5.017	
$G^{+} \neq > N^{-}$	**14.11**	10.574	6.569	4.59	0.003	$S^{-} \neq > D^{-}$	0.23	11.767	6.614	4.728	
$G^{+} \neq > NL^{+}$	4.175	12.675	8.829	6.759		$S^{-} \neq > D^{+}$	1.806	14.416	6.601	4.952	
$G^{+} \neq > NL^{+}$	5.629	12.2	8.948	6.902		$S^{+} \neq > D^{-}$	**5.591**	11.243	6.367	4.633	0.007
$G^{-} \neq > NL^{-}$	2.494	9.374	5.845	4.61		$S^{+} \neq > DK^{+}$	1.077	10.021	5.662	4.127	
$G^{-} \neq > NL^{+}$	**19.917**	9.089	6.128	4.847	0.003	$S^{-} \neq > DK^{-}$	0.535	10.068	6.347	4.506	
$G^{+} \neq > P^{+}$	6.037	12.713	8.516	6.661		$S^{-} \neq > DK^{+}$	2.149	10.04	6.366	4.856	
$G^{-} \neq > P^{-}$	4.012	9.867	6.439	4.935		$S^{+} \neq > DK^{-}$	**9.978**	9.267	5.364	4.342	-0.045
$G^{-} \neq > P^{+}$	1.648	11.644	6.53	4.769		$S^{+} \neq > E^{+}$	1.787	10.53	6.426	4.835	
$G^{+} \neq > P^{-}$	4.105	10.826	6.965	4.83		$S^{-} \neq > E^{-}$	0.751	10.862	6.476	4.627	
$G^{+} \neq > PL^{+}$	4.568	10.828	6.605	4.637		$S^{-} \neq > E^{+}$	0.49	12.226	6.169	4.738	
$G^{-} \neq > PL^{-}$	**15.028**	13.128	9.369	7.705	0.049	$S^{+} \neq > E^{-}$	**9.423**	10.646	5.724	4.589	-0.023
$G^{-} \neq > PL^{+}$	**5.563**	11.604	6.821	4.975	-0.08	$S^{+} \neq > F^{+}$	0.515	14.29	6.768	4.763	
$G^{+} \neq > PL^{-}$	**6.495**	10.349	6.846	5.278	0.003	$S^{-} \neq > F^{-}$	1.814	11.365	6.833	4.716	
$G^{+} \neq > SE^{+}$	3.465	13.17	8.168	6.547		$S^{-} \neq > F^{+}$	1.207	12.046	7.17	5.004	
$G^{-} \neq > SE^{-}$	**12.107**	12.667	9.299	7.57	0.064	$S^{+} \neq > F^{-}$	**6.072**	11.907	6.693	4.509	0.007
$G^{-} \neq > SE^{+}$	1.836	10.381	6.34	4.947		$S^{+} \neq > FIN^{+}$	1.346	12.266	6.11	4.675	
$G^{+} \neq > SE^{-}$	**12.198**	9.585	6.143	4.603	0.004	$S^{-} \neq > FIN^{-}$	0.221	10.808	6.095	4.652	
$G^{+} \neq > TR^{+}$	**16.691**	12.225	7.666	6.41	0.042	$S^{-} \neq > FIN^{+}$	1.526	10.984	6.225	4.588	
$G^{-} \neq > TR^{-}$	2.352	11.132	6.578	4.909		$S^{+} \neq > FIN^{-}$	**7.607**	9.546	6.046	4.686	-0.01
$G^{-} \neq > TR^{+}$	3.377	8.358	6.067	4.764		$S^{+} \neq > GB^{+}$	3.286	11.735	6.198	4.397	

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$G^{+} \neq> TR^{-}$	**21.856**	11.618	6.606	5.001	-0.036	$S^{-} \neq> GB^{-}$	0.806	10.209	5.757	4.464	
$O^{+} \neq> A^{+}$	0.33	10.947	6.442	4.625		$S^{-} \neq> GB^{+}$	1.2	11.377	6.703	4.678	
$O^{-} \neq> A^{-}$	1.78	10.439	6.246	4.594		$S^{+} \neq> GB^{-}$	**6.2**	10.96	6.691	4.685	-0.012
$O^{-} \neq> A^{+}$	**5.382**	11.345	6.483	4.816	0.168	$S^{+} \neq> GR^{+}$	0.796	10.346	6.427	4.681	
$O^{+} \neq> A^{-}$	2.549	14.205	7.68	5.089		$S^{-} \neq> GR^{-}$	2.482	11.515	7.895	6.16	
$O^{+} \neq> B^{+}$	1.932	10.944	6.556	4.581		$S^{-} \neq> GR^{+}$	2.268	14.022	6.858	4.848	
$O^{-} \neq> B^{-}$	0.73	9.652	6.413	4.789		$S^{+} \neq> GR^{-}$	0.359	9.193	5.827	4.598	
$O^{-} \neq> B^{+}$	1.001	11.225	6.859	4.725		$S^{+} \neq> I^{+}$	0.521	10.749	6.376	4.685	
$O^{+} \neq> B^{-}$	**10.328**	12.595	7.291	4.928	-0.07	$S^{-} \neq> I^{-}$	0.28	12.716	6.93	5.005	
$O^{+} \neq> CH^{+}$	**37.059**	21.146	16.633	14.37	0.036	$S^{-} \neq> I^{+}$	0.237	13.341	7.525	5.175	
$O^{-} \neq> CH^{-}$	**11.674**	14.703	9.783	8.181	0.015	$S^{+} \neq> I^{-}$	3.74	10.929	6.237	4.454	
$O^{-} \neq> CH^{+}$	**21.596**	22.656	17.391	14.7	-0.047	$S^{+} \neq> N^{+}$	1.922	11.192	5.9	4.438	
$O^{+} \neq> CH^{-}$	**57.255**	24.933	16.889	14.735	-0.072	$S^{-} \neq> N^{-}$	0.291	10.341	6.347	4.61	
$O^{+} \neq> D^{+}$	1.902	11.623	6.736	4.649		$S^{-} \neq> N^{+}$	0.882	11.649	6.186	4.817	
$O^{-} \neq> D^{-}$	3.526	10.146	6.654	5.013		$S^{+} \neq> N^{-}$	**5.427**	8.761	5.954	4.614	-0.007
$O^{-} \neq> D^{+}$	1.148	10.449	6.71	4.978		$S^{+} \neq> NL^{+}$	0.42	12.007	5.718	4.503	
$O^{+} \neq> D^{-}$	**5.976**	12.295	7.057	5.042	-0.041	$S^{+} \neq> NL^{+}$	2.231	9.644	6.196	4.874	
$O^{+} \neq> DK^{+}$	2.005	10.15	6.047	4.723		$S^{-} \neq> NL^{-}$	0.712	12.327	6.272	4.575	
$O^{-} \neq> DK^{-}$	0.853	10.58	6.395	4.427		$S^{-} \neq> NL^{+}$	**5.438**	10.598	6.569	4.637	-0.001
$O^{-} \neq> DK^{+}$	0.801	8.891	6.047	4.478		$S^{+} \neq> P^{+}$	0.596	11.141	6.107	4.697	
$O^{+} \neq> DK^{-}$	4.344	13.254	6.593	4.594		$S^{-} \neq> P^{-}$	2.491	12.47	6.602	4.852	
$O^{+} \neq> E^{+}$	1.09	9.53	6.154	4.66		$S^{-} \neq> P^{+}$	0.287	10.573	6.789	4.811	
$O^{-} \neq> E^{-}$	**5.869**	10.002	5.948	4.627	-0.045	$S^{+} \neq> P^{-}$	2.75	11.755	7.117	5.079	
$O^{-} \neq> E^{+}$	2.686	10.055	6.337	4.892		$S^{+} \neq> PL^{+}$	**6.598**	12.476	6.361	4.619	0.031
$O^{+} \neq> E^{-}$	**6.611**	10.573	6.263	4.682	-0.068	$S^{-} \neq> PL^{-}$	2.997	10.961	6.197	4.764	
$O^{+} \neq> F^{+}$	3.877	11.385	6.382	5.089		$S^{-} \neq> PL^{+}$	0.626	13.144	6.797	4.547	
$O^{-} \neq> F^{-}$	1.141	12.622	6.389	4.939		$S^{+} \neq> PL^{-}$	0.76	12.663	6.476	4.68	
$O^{-} \neq> F^{+}$	4.313	12.069	7.166	4.956		$S^{+} \neq> SE^{+}$	0.107	10.421	5.616	4.195	
$O^{+} \neq> F^{-}$	**16.013**	11.242	6.645	4.8	-0.028	$S^{-} \neq> SE^{-}$	1.758	10.174	6.057	4.441	
$O^{+} \neq> FIN^{+}$	2.106	10.422	5.954	4.573		$S^{-} \neq> SE^{+}$	0.633	11.404	6.328	4.87	
$O^{-} \neq> FIN^{-}$	2.193	10.795	6.152	4.883		$S^{+} \neq> SE^{-}$	3.3	11.33	6.447	4.62	
$O^{-} \neq> FIN^{+}$	2.908	9.639	6.141	4.722		$S^{+} \neq> TR^{+}$	**9.684**	11.271	6.552	4.832	0.066
$O^{+} \neq> FIN^{-}$	**6.995**	11.571	6.488	4.828	-0.05	$S^{-} \neq> TR^{-}$	0.157	11.378	5.897	4.779	
$O^{+} \neq> GB^{+}$	3.966	12.891	7.046	4.56		$S^{-} \neq> TR^{+}$	0.674	9.788	6.498	4.663	
$O^{-} \neq> GB^{-}$	0.153	10.805	6.806	5.081		$S^{+} \neq> TR^{-}$	**11.176**	11.539	6.062	4.573	-0.037

The symbol $A \neq B$ means that A does not cause B.
The optimal lag order in the VAR model was selected to be one based on the minimization of the HJC information criterion.

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Appendix II. Multivariate Diagnostic Tests for Normality and ARCH

	Multivariate Normality	Multivariate ARCH		Multivariate Normality	Multivariate ARCH		Multivariate Normality	Multivariate ARCH
G, A	200.7*	<.0001*	O, A	399.8*	0.0002*	S, A	287.6*	<.0001*
G^{+}, A^{+}	517.7*	0.1771	O^{+}, A^{+}	82.42*	0.9576	S^{+}, A^{+}	369.7*	0.8054
G^{-}, A^{-}	500.4*	0.8320	O^{-}, A^{-}	80.61*	0.9551	S^{-}, A^{-}	324.5*	0.9879
G^{-}, A^{+}	529.2*	0.9221	O^{-}, A^{+}	76.74*	0.1222	S^{-}, A^{+}	365.5*	0.1670
G^{+}, A^{-}	487.3*	0.2381	O^{+}, A^{-}	111.7*	0.9671	S^{+}, A^{-}	332.5*	0.3789
G, B	148.3*	<.0001*	O, B	338.9*	<.0001*	S, B	230.6*	<.0001*
G^{+}, B^{+}	394.8*	0.4851	O^{+}, B^{+}	86.28*	0.9950	S^{+}, B^{+}	458.2*	0.9487
G^{-}, B^{-}	386.5*	0.6722	O^{-}, B^{-}	100.6*	0.9793	S^{-}, B^{-}	434.9*	0.8644
G^{-}, B^{+}	395.8*	0.3880	O^{-}, B^{+}	119.9*	0.1264	S^{-}, B^{+}	486.5*	0.1082
G^{+}, B^{-}	385.3*	0.4517	O^{+}, B^{-}	88.26*	0.9149	S^{+}, B^{-}	405.5*	0.4853
G, CH	365.5*	<.0001*	O, CH	535.6*	0.0003*	S, CH	433.9*	0.0001*
G^{+}, CH^{+}	485.8*	0.9498	O^{+}, CH^{+}	74.88*	0.9927	S^{+}, CH^{+}	886.2*	0.9892
G^{-}, CH^{-}	467.3*	0.3664	O^{-}, CH^{-}	88.55*	0.8203	S^{-}, CH^{-}	886.6*	0.7317
G^{-}, CH^{+}	491.4*	0.8126	O^{-}, CH^{+}	83.42*	0.2006	S^{-}, CH^{+}	929.2*	0.5959
G^{+}, CH^{-}	463.5*	0.2156	O^{+}, CH^{-}	70.92*	0.5901	S^{+}, CH^{-}	841.4*	0.1445
G, D	254.3*	<.0001*	O, D	433.8*	<.0001*	S, D	332.8*	<.0001*
G^{+}, D^{+}	127.5*	0.7015	O^{+}, D^{+}	143.6*	0.9445	S^{+}, D^{+}	131.9*	0.9945
G^{-}, D^{-}	126.1*	0.1652	O^{-}, D^{-}	127.8*	0.8885	S^{-}, D^{-}	120.3*	0.9299
G^{-}, D^{+}	123.9*	0.1086	O^{-}, D^{+}	126.8*	0.7015	S^{-}, D^{+}	135.1*	0.4243
G^{+}, D^{-}	129.2*	0.2302	O^{+}, D^{-}	150.7*	0.8925	S^{+}, D^{-}	117.1*	0.3296
G, DK	139.1*	<.0001*	O, DK	331.1*	0.0055*	S, DK	234.9*	0.0012*
G^{+}, DK^{+}	307.2*	0.4289	O^{+}, DK^{+}	161.7*	0.9884	S^{+}, DK^{+}	204.4*	0.9815
G^{-}, DK^{-}	294.7*	0.3487	O^{-}, DK^{-}	175.2*	0.8774	S^{-}, DK^{-}	182.8*	0.9729
G^{-}, DK^{+}	305.2*	0.1480	O^{-}, DK^{+}	161.2*	0.6527	S^{-}, DK^{+}	223.1*	0.2857
G^{+}, DK^{-}	295.9*	0.2448	O^{+}, DK^{-}	169.5*	0.8566	S^{+}, DK^{-}	167.8*	0.4421
G, E	58.71*	<.0001*	O, E	253.7*	0.0006*	S, E	154.2*	0.0004*
G^{+}, E^{+}	223.4*	0.2581	O^{+}, E^{+}	162.4*	0.8632	S^{+}, E^{+}	76.39*	0.9744
G^{-}, E^{-}	224.1*	0.3159	O^{-}, E^{-}	149.8*	0.5801	S^{-}, E^{-}	64.87*	0.7391
G^{-}, E^{+}	228.5*	0.1702	O^{-}, E^{+}	143.4*	0.2692	S^{-}, E^{+}	79.58*	0.1430
G^{+}, E^{-}	230.4*	0.4514	O^{+}, E^{-}	172.3*	0.2336	S^{+}, E^{-}	65.04*	0.3662
G, F	101.9*	<.0001*	O, F	313.6*	<.0001*	S, F	194.1*	<.0001*
G^{+}, F^{+}	225.8*	0.2978	O^{+}, F^{+}	139.4*	0.9357	S^{+}, F^{+}	123.3*	0.9357

G^-, F^-	225.4*	0.1942	O^-, F^-	127.2*	0.6461	S^-, F^-	120.7*	0.3513
G^-, F^+	225.1*	0.0020*	O^-, F^+	117.7*	0.3369	S^-, F^+	139.8*	0.1216
G^+, F^-	227.3*	0.2975	O^+, F^-	160.8*	0.7661	S^+, F^-	106.3*	0.1787
G, FIN	83.69*	0.0007*	O, FIN	292.4*	0.0023*	S, FIN	180.5*	0.2616
G^+, FIN^+	262.6*	0.7687	O^+, FIN^+	127.8*	0.9792	S^+, FIN^+	235.1*	0.9826
G^-, FIN^-	259.0*	0.5220	O^-, FIN^-	101.4*	0.9778	S^-, FIN^-	241.2*	0.9177
G^-, FIN^+	258.6*	0.0160**	O^-, FIN^+	97.39*	0.1757	S^-, FIN^+	251.5*	0.1912
G^+, FIN^-	260.8*	0.1439	O^+, FIN^-	139.3*	0.9272	S^+, FIN^-	220.6*	0.1827
G, GB	186.6*	<.0001*	O, GB	419.2*	<.0001*	S, GB	256.9*	<.0001*
G^+, GB^+	509.0*	0.6057	O^+, GB^+	86.57*	0.9457	S^+, GB^+	705.1*	0.8704
G^-, GB^-	504.4*	0.4069	O^-, GB^-	127.5*	0.9185	S^-, GB^-	672.6*	0.6203
G^-, GB^+	526.6*	0.3224	O^-, GB^+	123.8*	0.2189	S^-, GB^+	729.7*	0.6321
G^+, GB^-	496.4*	0.1324	O^+, GB^-	64.41*	0.1960	S^+, GB^-	638.5*	0.6093
G, GR	203.3*	0.0076*	O, GR	371.9*	0.0027*	S, GR	308.6*	<.0001*
G^+, GR^+	294.5*	0.9031	O^+, GR^+	852.1*	0.9428	S^+, GR^+	334.8*	0.8560
G^-, GR^-	313.2*	0.8225	O^-, GR^-	809.8*	0.9930	S^-, GR^-	336.6*	0.9747
G^-, GR^+	308.8*	0.3954	O^-, GR^+	795.2*	0.9942	S^-, GR^+	331.2*	0.9957
G^+, GR^-	300.3*	0.7084	O^+, GR^-	863.4*	0.9869	S^+, GR^-	338.4*	0.9354
G, I	48.02*	0.0115**	O, I	239.1*	0.0056*	S, I	146.8*	<.0001*
G^+, I^+	107.2*	0.1177	O^+, I^+	172.5*	0.7888	S^+, I^+	191.6*	0.9283
G^-, I^-	112.9*	0.3327	O^-, I^-	159.2*	0.8902	S^-, I^-	176.8*	0.8126
G^-, I^+	112.8*	0.1045	O^-, I^+	154.2*	0.2660	S^-, I^+	182.5*	0.5079
G^+, I^-	116.3*	0.6498	O^+, I^-	179.7*	0.9411	S^+, I^-	185.7*	0.7881
G, N	248.2*	<.0001	O, N	499.1*	0.0094*	S, N	336.2*	<.0001*
G^+, N^+	761.7*	0.2718	O^+, N^+	179.4*	0.8988	S^+, N^+	1043,1*	0.5140
G^-, N^-	762.3*	0.1540	O^-, N^-	205.8*	0.9240	S^-, N^-	1020.1*	0.8878
G^-, N^+	775.6*	0.0062*	O^-, N^+	220.2*	0.7826	S^-, N^+	1046.1*	0.3829
G^+, N^-	747.3*	0.3749	O^+, N^-	145.4*	0.9697	S^+, N^-	1001.2*	0.8714
G, NL	184.4*	<.0001*	O, NL	364.6*	<.0001*	S, NL	261.1*	0.0012*
G^+, NL^+	312.6*	0.5262	O^+, NL^+	118.1*	0.9842	S^+, NL^+	170.9*	0.9715
G^+, NL^+	308.3*	0.2720	O^+, NL^+	152.6*	0.5953	S^+, NL^+	165.4*	0.2859
G^-, NL^-	312.6*	0.2488	O^-, NL^-	161.2*	0.1754	S^-, NL^-	185.8*	0.2716
G^-, NL^+	308.7*	0.0020*	O^-, NL^+	96.56*	0.3565	S^-, NL^+	152.3*	0.1283
G, P	45.87*	0.0018*	O, P	197.1*	0.0005*	S, P	135.7*	0.0619***
G^+, P^+	350.2*	0.4401	O^+, P^+	716.6*	0.7343	S^+, P^+	361.8*	0.5551
G^-, P^-	346.8*	0.8223	O^-, P^-	696.9*	0.8887	S^-, P^-	363.5*	0.9139

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G^-, P^+	356.9*	0.5217	O^-, P^+	676.1*	0.9672	S^-, P^+	355.2*	0.8626
G^+, P^-	347.7*	0.8922	O^+, P^-	734.2*	0.9594	S^+, P^-	370.2*	0.9472
G^- PL	170.7*	0.0009*	O^- PL	383.9*	0.0015*	S^- PL	262.4*	0.0009*
G^+, PL^+	832.7*	0.9163	O^+, PL^+	113.6*	0.6522	S^+, PL^+	206.7*	0.7679
G^-, PL^-	773.1*	0.2245	O^-, PL^-	92.86*	0.4918	S^-, PL^-	202.7*	0.5944
G^-, PL^+	829.5*	0.0158**	O^-, PL^+	74.49*	0.0934***	S^-, PL^+	213.7*	0.2365
G^+, PL^-	778.2*	0.3493	O^+, PL^-	150.1*	0.7578	S^+, PL^-	189.7*	0.5641
G, SE	168.7*	<.0001*	O, SE	396.6*	0.0001*	S, SE	258.1*	<.0001*
G^+, SE^+	476.4*	0.5314	O^+, SE^+	98.22*	0.9607	S^+, SE^+	502.2*	0.9964
G^-, SE^-	461.2*	0.2764	O^-, SE^-	107.7*	0.9854	S^-, SE^-	462.3*	0.9980
G^-, SE^+	480.4*	0.3436	O^-, SE^+	116.2*	0.1826	S^-, SE^+	510.6*	0.1602
G^+, SE^-	455.4*	0.1332	O^+, SE^-	91.94*	0.8610	S^+, SE^-	447.6*	0.8848
G, TR	134.5*	<.0001*	O, TR	294.2*	0.0001*	S, TR	229.2*	0.0121**
G^+, TR^+	338.1*	0.3247	O^+, TR^+	419.8*	0.6956	S^+, TR^+	145.1*	0.4834
G^-, TR^-	348.2*	0.6748	O^-, TR^-	349.2*	0.7986	S^-, TR^-	144.8*	0.6807
G^-, TR^+	327.2*	0.4983	O^-, TR^+	320.6*	0.2451	S^-, TR^+	130.6*	0.1715
G^+, TR^-	346.7*	0.5554	O^+, TR^-	447.4*	0.7179	S^+, TR^-	157.4*	0.5096

*,**, *** shows significance at 1%, 5% and 10% level.

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