Granger's Causality test

A standard Granger's causality test addresses the question (in the case of two time-series variables, X and Y) of whether Y can be better predicted using the histories of both X and Y than it can by using the history of Y alone. If the answer is affirmative one can say that X Granger-causes Y. The formal test with p lags is given by,

$$Y_t = a_0 + a_1 Y_{t-1} + ... + a_p Y_{t-p} + b_1 X_{t-1} + ... + b_p X_{t-p} + u_t \quad (1)$$

$$X_t = c_0 + c_1 X_{t-1} + ... + c_p Y_{t-p} + d_1 Y_{t-1} + ... + d_p Y_{t-p} + v_t \quad (2)$$

Then, an F test is conducted to test whether $H_0 : b_1 = ... = b_p = 0$ against H_A: at least one of $b_i \neq 0$. If one cannot reject the H_0, X does not Granger-cause Y. Similarly, testing $H_0 : d_1 = ... = d_p = 0$ against H_A tests whether Y does not Granger-cause X.
Screen example with weekly frequency and 5 lags $p = 5$ is depicted below:

Granger Test Prob. (Months)

GRANGER's CAUSALITY TEST - ALL OBSERVATIONS

(Upper matrix HO: line =/=> column; Lower matrix HO: column =/=> line)

	Representative.ER	X10Y.InfExp	NASDAQ100.stock.index	TA.Industry
Representative.ER	1	0.727	0.885	0.425
X10Y.InfExp	0.654	1	0.92	0.674
NASDAQ100.stock.index	0.219	0.061	1	0.802
TA.Industry	0.062	0.053	0.002	1

Granger Test Prob. (Months)

GRANGER's CAUSALITY TEST - OBSERVATIONS WITHOUT OUTLIERS

(Upper matrix HO: line =/=> column; Lower matrix HO: column =/=> line)

	Representative.ER	X10Y.InfExp	NASDAQ100.stock.index	TA.Industry
Representative.ER	1	0.313	0.227	0.935
X10Y.InfExp	0.505	1	0.404	0.415
NASDAQ100.stock.index	0.747	0.397	1	0.347
TA.Industry	0.635	0.47	0.346	1

The upper panel presents the entire sample while the lower depicts only 'normal' observations (without outliers based on the Mahalanobis method - set at a threshold of 0.9 - see the help on Mahalanobis). Each panel consists of three variables and is divided into upper and lower triangle showing P-values of the Granger causality tests between pairs of

variables. The null of the upper triangle is that a variable in a column does not Granger cause the variables in a line, while the null of the lower triangle is that a variables in a line does not Granger cause a variable in a column. For figures below 0.05, the null that the first variable does not Granger cause the second variable is rejected. For example regarding the upper panel, the null that the Nasdaq100 (Nasdaq100.stock.index) does not Granger cause Tel-Aviv industry sector stocks (TA.industry) is significantly rejected (0.002) while the opposite cannot be rejected (0.802). Note that after excluding outliers (in the lower panel) both nulls cannot be rejected (0.346 and 0.347, respectively).