

Results of the empirical research

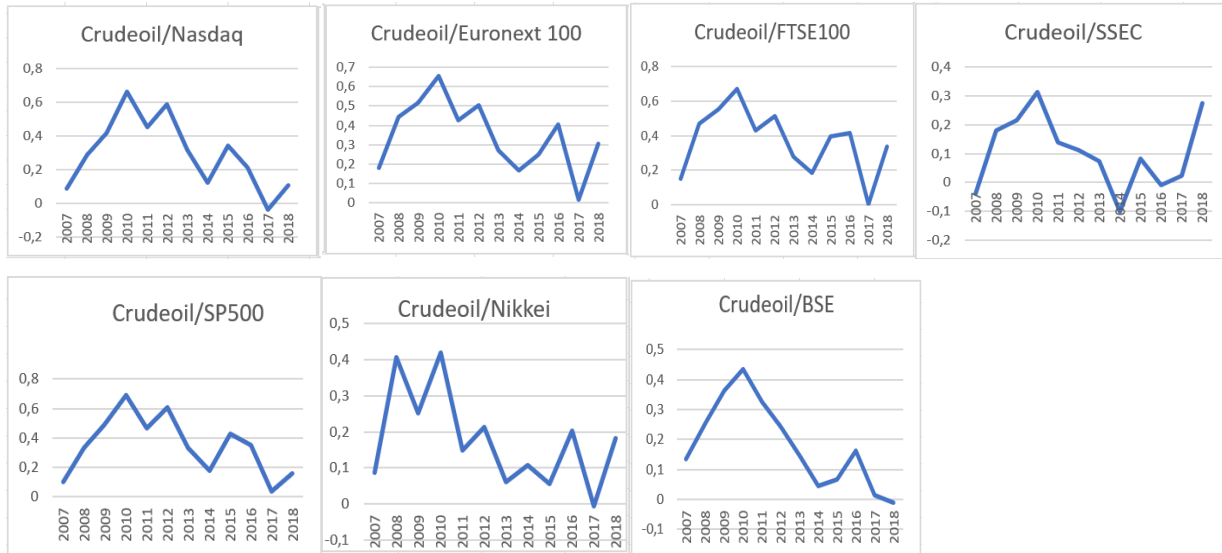


Figure1. Correlation of Crude oil and stock market indexes returns.

Note: developed by the author.

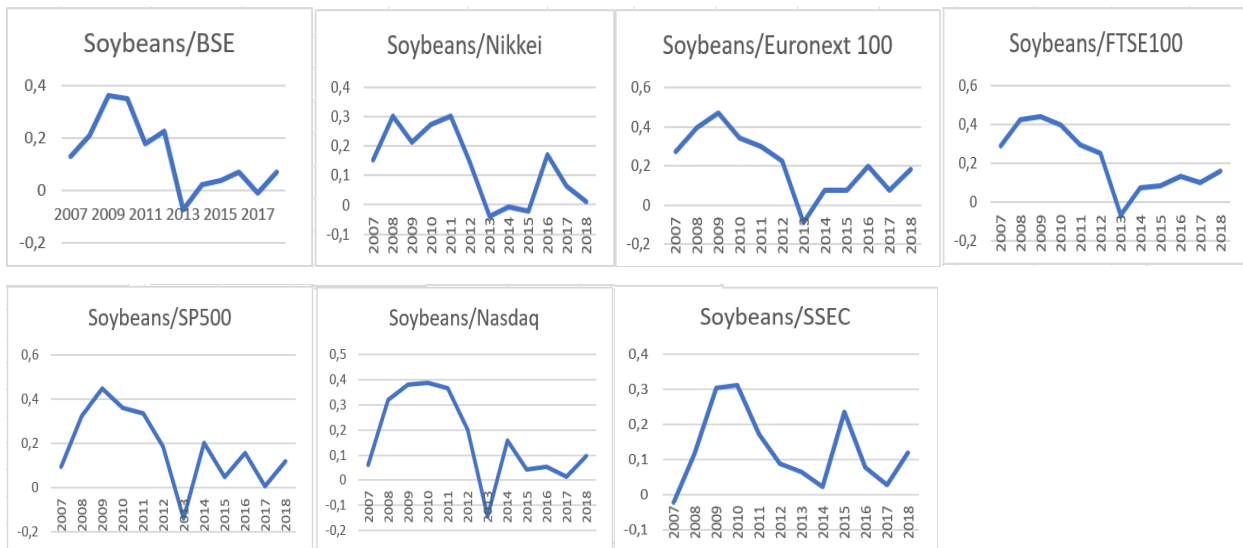
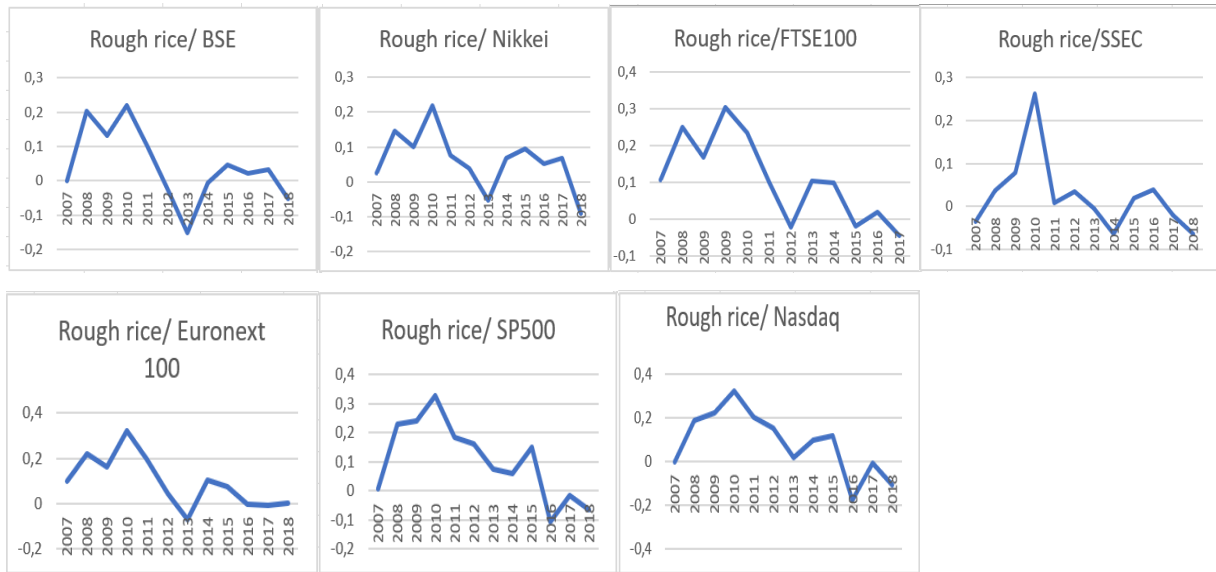


Figure 2. Correlation of Soybeans and stock market indexes returns.

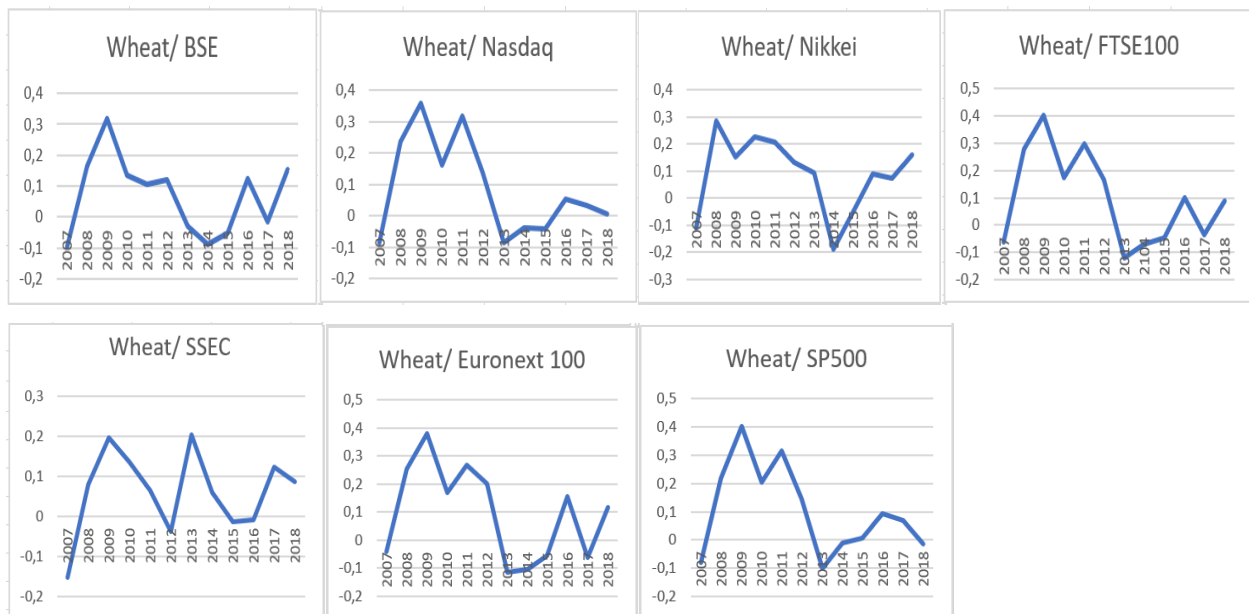
Note: developed by the author.

**ANNEX 3 continued**



**Figure 3. Correlation of Rough rice and stock indexes returns.**

Note: developed by the author.



**Figure 4. Correlation of Wheat and Stock market indexes.**

Note: developed by the auth

Table 1.

**Annualized Standard deviation of log return of commodity and stock indexes 2007-2018**

	Soybeans	Crude oil	Gold	Rough rice	Wheat	S&P 500	Nasdaq	FTSE 100	Eurone xt 100	SSEC	BSE	Nikkei
2007	26,74%	31,66%	18,31%	18,71%	38,94%	18,06%	19,61%	20,02%	17,45%	<b>38,63%</b>	29,67%	21,15%
2008	<b>47,84%</b>	<b>63,82%</b>	<b>33,64%</b>	<b>39,85%</b>	<b>54,51%</b>	<b>44,18%</b>	<b>44,56%</b>	<b>41,86%</b>	<b>42,98%</b>	<b>47,98%</b>	<b>51,62%</b>	<b>52,07%</b>
2009	<b>36,49%</b>	<b>66,13%</b>	<b>22,19%</b>	<b>29,53%</b>	<b>42,62%</b>	<b>30,84%</b>	<b>31,76%</b>	<b>27,19%</b>	<b>28,38%</b>	<b>33,67%</b>	<b>38,96%</b>	<b>30,28%</b>
2010	26,04%	37,07%	18,36%	32,71%	46,35%	21,38%	23,95%	21,96%	26,32%	27,43%	19,09%	24,44%
2011	23,28%	39,75%	21,61%	29,26%	43,37%	25,98%	28,26%	22,08%	26,02%	20,15%	22,23%	25,39%
2012	25,38%	27,12%	16,65%	21,32%	37,24%	14,40%	17,05%	14,37%	19,09%	18,90%	15,57%	18,93%
2013	21,65%	19,62%	24,20%	20,15%	20,97%	13,12%	14,28%	13,30%	15,29%	20,15%	18,95%	28,85%
2014	25,97%	27,05%	16,23%	26,97%	29,98%	12,25%	15,42%	13,15%	17,41%	19,53%	14,09%	23,14%
2015	20,97%	48,45%	15,36%	26,24%	33,85%	18,19%	20,04%	19,27%	24,32%	<b>44,64%</b>	17,36%	23,88%
2016	23,96%	48,87%	17,05%	33,19%	24,31%	14,38%	18,03%	18,09%	21,53%	25,63%	16,26%	27,38%
2017	16,77%	26,40%	11,18%	23,01%	26,93%	7,16%	10,46%	9,36%	9,92%	9,71%	9,54%	13,00%
2018	20,56%	30,61%	10,69%	28,58%	32,01%	17,53%	22,31%	14,30%	14,75%	20,91%	14,21%	19,97%

Note: author's calculations.

## ANNEX 3 continued

**Table 2**

### AIC lag order selection for a cointegration test

lags	loglik	p(LR)	AIC	BIC	HQC
1	-100531.34971		83.991114	84.309520	84.106958
2	-99987.55370	0.00000	83.638343*	84.248622*	83.860377*
3	-99870.34436	0.00000	83.641506	84.543657	83.969730
4	-99806.43570	0.31813	83.689141	84.883166	84.123556
5	-99724.43910	0.00566	83.721685	85.207582	84.262290
6	-99609.71025	0.00000	83.726917	85.504687	84.373712
7	-99538.35072	0.08649	83.768336	85.837979	84.521321
8	-99442.79265	0.00005	83.789564	87.137057	84.648740
9	-99381.42325	0.43878	83.839319	86.492706	84.804684
10	-99289.53532	0.00020	83.863609	86.808869	84.935165
11	-99212.05850	0.02026	83.899924	87.137057	85.077670
12	-99127.07311	0.00223	83.929973	87.458979	85.213910
13	-99053.02302	0.04757	83.969147	87.790026	85.359274

Note: authors calculations

**Table 3**

### AIC lag order selection for VAR model (Hypothesis 3)

lags	loglik	p(LR)	AIC	BIC	HQC
1	58936.79717		-49.135891	-48.962155*	-49.072680*
2	59053.11714	0.00000	-49.179564	-48.851395	-49.060166
3	59109.58538	0.00016	-49.173277	-48.690676	-48.997691
4	59183.00051	0.00000	-49.181136*	-48.544103	-48.949363
5	59244.00361	0.00002	-49.178634	-48.387169	-48.890674
6	59290.97904	0.00873	-49.164423	-48.218526	-48.820276
7	59352.10690	0.00002	-49.162026	-48.061696	-48.761691
8	59400.21928	0.00567	-49.148764	-47.894002	-48.692242
9	59463.16232	0.00001	-49.147882	-47.738688	-48.635172
10	59513.00885	0.00286	-49.136067	-47.572441	-48.567171
11	59583.76503	0.00000	-49.141707	-47.423649	-48.516623
12	59624.86358	0.06241	-49.122591	-47.250100	-48.441319
13	59678.28827	0.00063	-49.113763	-47.086840	-48.376305

Note: authors calculations.

Table 4

**Impulse Response of stock market indexes to the shock in Crude oil**

	ld_Nikkei	ld_BSE	ld_SSEC	ld_SP500	ld_Nasdaq	ld_FTSE100	ld_Euronext 100
1	0.0036263	0.0035714	0.0023612	0.0051536	0.0048856	0.0053821	0.0055191
2	0.0015879	0.00044778	0.001246	-0.0004529	-0.00027647	-0.00018859	-5.5431e-005
3	0.00038019	-0.00012562	-0.00051594	-6.1926e-005	-0.00028539	-0.00026760	-0.0001185
4	-9.3263e-005	-0.00010295	0.00047403	-0.00011504	-0.00011635	-0.00037539	-0.00018882
5	-0.00027947	-0.00056054	3.2169e-005	-0.00013268	-0.00016021	0.00016011	-0.00011126
6	-0.00018494	-0.00010357	2.0173e-005	-0.00012987	-0.00010862	-0.00024484	-0.0002578
7	-0.00014298	-3.2865e-005	-6.4697e-005	-1.7055e-005	-1.9977e-005	1.6777e-005	-2.603e-006
8	5.3015e-005	7.7658e-005	4.2728e-005	1.7766e-005	2.4189e-005	4.8718e-005	4.3596e-005
9	-3.1294e-006	-7.5192e-006	-1.01e-005	2.015e-005	1.0938e-005	-1.4409e-005	3.1243e-006
10	3.9807e-006	9.7385e-006	-2.0158e-005	-1.101e-005	-7.3198e-006	4.5878e-006	4.1436e-006

Note: author's calculations.

Table 5

**Impulse Response of the Crude oil to the shock in stock market indexes**

Period (days)	ld_Nikkei225	ld_BSE30	ld_SSEC	ld_SP500	ld_Nasdaq	ld_FTSE100	ld_Euronext 100
1	0	0	0	0.0073155	0	0	0
2	2.196e-005	0.00083789	-0.0007981	0.0024257	0.00030092	0.00066327	-0.00091364
3	0.00055829	8.0411e-005	0.00022279	-0.00090062	0.0015696	-0.00079869	-0.00054274
4	-0.00045182	-0.00049607	-0.00014452	-0.00021424	0.00072855	0.00065853	0.00044821
5	-0.0012052	0.0011937	-0.00011938	0.00033099	0.00025437	0.00041776	-0.00062768
6	0.00056623	-0.0001758	6.4686e-005	-0.00061978	-0.00010233	-6.8702e-005	0.00015376
7	3.487e-007	-3.7998e-006	3.696e-005	9.4975e-006	-0.00021558	-2.8562e-006	-3.5968e-005
8	3.9219e-005	1.8322e-005	1.6929e-005	-9.0154e-006	6.3258e-005	-0.0001002	7.7203e-005
9	6.7228e-005	-3.8906e-005	0.00012908	-1.2505e-005	-2.1437e-005	-5.6929e-005	-7.4815e-005
10	-2.7031e-005	1.4051e-005	-6.3684e-006	-2.5708e-005	5.0162e-005	1.5257e-005	5.3515e-005

Note: author's calculations.

**ANNEX 3 continued****Table 6****AIC lag order selection for VAR model ( Hypothesis 4)**

<b>lags</b>	<b>loglik</b>	<b>p(LR)</b>	<b>AIC</b>	<b>BIC</b>	<b>HQC</b>
1	72035.60279		-60.038066	-59.772635*	-59.941494*
2	72163.14526	0.00000	-60.061056*	-59.554325	-59.876692
3	72247.36738	0.00002	-60.047886	-59.299855	-59.775729
4	72336.28794	0.00000	-60.038638	-59.049306	-59.678688
5	72431.71504	0.00000	-60.034821	-58.804189	-59.587078
6	72508.99324	0.00038	-60.015854	-58.543922	-59.480319
7	72598.30558	0.00000	-60.006933	-58.293701	-59.383605
8	72656.00106	0.13927	-59.971620	-58.017088	-59.260500
9	72730.41408	0.00112	-59.950262	-57.754429	-59.151349
10	72810.14212	0.00015	-59.933341	-57.496207	-59.046635
11	72893.30851	0.00004	-59.919289	-57.240856	-58.944790
12	72939.14429	0.71178	-59.874077	-56.954343	-58.811786
13	73009.16103	0.00511	-59.849049	-56.688015	-58.698965

Note: authors calculations

Table 7

**Response of Soybeans to the shock in stock indexes**

Period (days)	ld_Nikkei225	ld_BSE30	ld_SSEC	ld_SP500	ld_Nasdaq	ld_FTSE100	ld_Euronext 100
1	0	0	0	0	0	0	0
2	-1.6846e-005	9.7899e-005	-0.00049139	0.00049379	0.00044669	-9.6309e-005	-0.0010453
3	-1.3799e-005	0.00043049	-0.00030372	-0.00044159	-0.00023864	-0.00019462	0.00019826
4	-1.4673e-005	-5.8887e-005	-3.1408e-005	-3.0416e-005	-3.3271e-005	6.7867e-005	-6.7309e-006
5	-9.2006e-006	-3.9076e-007	-2.2275e-005	0.00010086	3.0819e-006	-1.9462e-005	-1.2007e-005
6	8.8229e-006	5.3124e-006	9.0542e-007	-1.5724e-005	7.8563e-006	5.1383e-006	-1.9991e-007
7	-4.3233e-006	7.7007e-007	-2.5146e-006	-7.2119e-006	2.4352e-006	-2.2778e-006	2.1647e-006
8	7.4875e-007	-7.9292e-007	3.0865e-007	3.01e-006	-1.7661e-006	2.0356e-007	-6.6675e-007
9	2.7482e-007	4.4643e-007	-2.5914e-007	2.5711e-007	-3.4078e-007	1.8448e-007	-3.0301e-008
10	-2.0353e-007	-2.6922e-008	2.3666e-008	-2.4757e-007	3.4052e-007	-7.8527e-008	8.3177e-008

Note: author's calculations.

Table 8

## Response from the stock market indexes to the shock in Soybeans

Period (days)	ld_Nikkei225	ld_BSE30	ld_SSEC	ld_SP500	ld_Nasdaq	ld_FTSE100	ld_Euronext 100
1	0.0027833	0.0027735	0.0025265	0.0035133	0.0035074	0.0036712	0.0038292
2	0.0011375	0.00038945	0.0006689	8.4462e-005	0.00024009	0.00016711	7.2263e-006
3	0.00060568	0.00082547	0.00013755	-5.1765e-005	-0.00017429	-0.00014331	-0.00016767
4	-0.00018616	-0.00017373	-0.00010404	5.1337e-005	4.2783e-005	4.0851e-005	4.9797e-005
5	1.2301e-005	1.5159e-005	4.9985e-005	-2.3381e-005	-1.0721e-006	-9.0383e-006	-1.2221e-005
6	-2.242e-007	1.0085e-005	-6.6532e-006	1.3686e-006	-3.8136e-006	-3.4771e-006	-7.6476e-006
7	3.5292e-006	-5.2921e-006	-2.9593e-006	4.9466e-006	2.9327e-006	3.3072e-006	5.7246e-006
8	-8.7129e-008	1.4254e-006	2.0709e-006	-1.7503e-006	-7.5029e-007	5.0793e-009	-3.5635e-007
9	-5.5664e-007	3.8723e-007	-2.2261e-007	-4.3712e-007	-5.0435e-007	-7.9435e-007	-1.0815e-006
10	-8.6849e-008	-4.6049e-007	-3.1211e-007	3.605e-007	2.802e-007	1.5947e-007	2.7829e-007

Note: author's calculations.

Table 9

**Response of Rough rice to the shock in stock market indexes**

Period (days)	ld_Nikkei225	ld_BSE30	ld_SSEC	ld_SP500	ld_Nasdaq	ld_FTSE100	ld_Euronext 100
1	0	0	0	0	0	0	0
2	-4.3782e-005	-0.00055058	-0.00037986	0.00018499	6.6159e-005	-0.00016473	-0.00072682
3	4.486e-005	0.00090406	-0.00022463	0.00028833	0.00046985	0.00010528	4.2629e-005
4	-3.4393e-005	-4.0638e-005	-2.2443e-005	-4.4217e-006	5.5795e-005	4.4637e-005	7.3155e-005
5	-2.2133e-006	1.9709e-006	-6.0806e-005	9.9725e-005	-8.4343e-005	-1.5392e-005	-3.3403e-005
6	9.7049e-006	8.8377e-006	-1.2333e-006	-2.3347e-005	6.5014e-006	8.575e-006	-1.0204e-005
7	-8.498e-006	-4.4269e-006	-1.8917e-006	-8.3129e-006	8.1039e-006	-6.6491e-006	9.1267e-006
8	2.1301e-006	-8.2317e-007	5.0992e-007	3.8368e-006	-3.0103e-006	4.1432e-007	-1.7834e-006
9	3.8906e-007	1.1468e-006	-3.3968e-007	-2.3734e-007	-2.6305e-007	3.403e-007	-3.0202e-007
10	-3.9199e-007	-1.9622e-007	7.9405e-008	-2.1587e-007	4.7559e-007	-1.1626e-007	3.7981e-007

Note: author's calculations

Table 10

## Response from the stock market indexes to the Rough rice shock

Period (days)	ld_Nikkei225	ld_BSE30	ld_SSEC	ld_SP500	ld_Nasdaq	ld_FTSE100	ld_Euronext 100
1	0.0005271	0.00052947	-1.0426e-005	0.0011325	0.00092251	0.00092523	0.00087527
2	0.00070202	0.0002671	0.00018273	0.00016124	2.5374e-005	0.00015083	0.00012788
3	8.471e-005	0.00026322	-0.00044156	0.00014913	0.00012568	0.00013343	0.00010323
4	6.6786e-005	6.9914e-005	3.3e-005	-3.1907e-006	1.7857e-005	4.1249e-005	3.3139e-005
5	6.1849e-006	2.6618e-005	2.2299e-005	-1.4991e-005	-1.7053e-005	-2.5633e-005	-2.8428e-005
6	-8.0893e-006	-1.191e-005	-9.79e-006	5.0028e-006	2.9999e-006	-1.7769e-007	1.0009e-006
7	1.2733e-006	-6.6209e-008	2.5109e-006	3.7096e-007	1.0308e-006	2.4298e-006	2.6348e-006
8	6.235e-007	1.5688e-006	5.0847e-007	-5.7947e-007	-6.763e-007	-4.6063e-007	-8.0476e-007
9	-1.2523e-007	-3.4634e-007	-4.4904e-007	1.6999e-007	5.5181e-008	-1.3829e-007	-7.985e-008
10	-7.6599e-008	-7.5512e-008	6.1309e-008	-8.9632e-009	4.4359e-008	7.7475e-008	9.0565e-008

Note: author's calculations.

Table 11

## Response of stock market indexes to the shock in Wheat

Period (days)	ld_Nikkei225	ld_BSE30	ld_SSEC	ld_SP500	ld_Nasdaq	ld_FTSE100	ld_Euronext 100
1	0.00081652	0.00041221	-0.00027339	0.00076811	0.0007722	0.00043494	0.00048632
2	-0.00010324	-0.00037815	0.00016626	-0.00035978	-0.00037419	-0.00014023	-0.00015675
3	-0.0002027	0.00036882	-0.000329	0.00056848	0.00075912	0.0005016	0.00054052
4	0.00043729	0.00018504	0.00021104	1.9926e-006	-2.2108e-006	7.6373e-005	9.0329e-005
5	2.8063e-005	3.3181e-005	-3.0041e-005	-3.5038e-006	-2.0135e-005	-1.1002e-005	-4.8451e-006
6	-2.5898e-005	-2.4455e-005	-8.7997e-006	-5.1245e-006	-2.1237e-008	-1.5406e-005	-1.416e-005
7	-2.5883e-006	2.9617e-006	2.1798e-008	-1.3258e-006	-4.3063e-007	1.5574e-006	1.9102e-007
8	1.65e-006	2.1494e-007	7.2151e-008	1.873e-006	9.7799e-007	1.5323e-006	1.7481e-006
9	9.3893e-007	2.1644e-007	2.79e-007	2.1553e-008	4.6801e-008	-3.0662e-008	1.4983e-007
10	-2.6989e-007	1.2562e-007	5.392e-009	-3.0381e-007	-2.2981e-007	-1.5655e-007	-2.6368e-007

Note: author's calculations.

Table 12

**The Impulse response from the Wheat to the shock of stock market indexes**

Period (days)	ld_Nikkei225	ld_BSE30	ld_SSEC	ld_SP500	ld_Nasdaq	ld_FTSE100	ld_Euronext 100
1	0	0	0	0	0	0	0
2	-0.00039673	-0.00012534	1.8372e-005	0.0006587	-0.00025972	-7.9029e-005	-0.00050561
3	-6.0935e-005	0.0004204	-0.00047661	-2.0121e-005	-0.00044935	-0.0008003	0.00036009
4	5.6988e-005	-3.9225e-005	-9.1464e-006	-0.00013691	8.1425e-005	0.00011367	-2.9475e-005
5	-3.4947e-005	-4.9794e-005	-1.4238e-005	2.1192e-005	3.2593e-005	-3.9891e-005	3.8323e-005
6	1.4731e-005	4.0235e-006	5.958e-006	1.1635e-005	-1.533e-005	4.9728e-006	-1.1426e-005
7	-9.1752e-007	5.7944e-006	-9.4627e-007	-8.2084e-006	3.4847e-006	1.0042e-006	9.8825e-007
8	-1.7049e-006	-2.0845e-006	5.7184e-007	1.3093e-006	1.123e-006	-7.8275e-007	1.5098e-006
9	7.9599e-007	-1.5865e-008	-1.2275e-007	1.03e-006	-9.4094e-007	2.2443e-007	-6.5332e-007
10	-4.4643e-008	2.9653e-007	-4.1665e-008	-4.6601e-007	1.5351e-007	4.9252e-008	-3.7532e-008

Note: author's calculations.