Understanding dynamic conditional correlations between oil, natural gas, and non-energy commodity futures markets

Online Appendix

A.1 Additional descriptive statistics

We provide in this Section further descriptive statistics. Table A.1 reports the correlation matrix for commodity futures returns, which are the dependent variables of the multivariate-GARCH models estimated in the first step of our empirical analysis.

[TABLE A.1 ABOUT HERE]

Table A.2 shows the descriptive statistics for the set of explanatory variables used in the ARDL(1,1) model presented in Tables 5 and 6 in the paper.

[TABLE A.2 ABOUT HERE]

A.2 Further Robustness checks

We discuss here some robustness checks using alternative definitions for our explanatory variables. While the Working's T (1960) index is by construction a measure of "excess" speculation, such distinction between "normal" and "excessive" speculation has been criticized following the argument that if there is no speculation in the physical market at all there cannot be excessive speculation either under any definition (Kilian and Murphy, 2014). Thus, we report some robustness checks adopting alternative measures of trading activity. In line with Bunn et al. (2017), we present results using two different measures: the investor sentiment (Han, 2000) and the hedging pressure (de Roon et al., 2000).

The model by de Roon et al. (2000) implies that risk premia for a future contract is determined by a systematic risk component and hedging pressure for all nonmarketable risks, which reflects all

nonmarketable positions that agents may face. We compute hedging pressure, measured according to their definition, as the ratio between the difference between short non-commercial positions and long non-commercial positions over total non-commercial positions for each of the 10 futures markets we consider. We also compare our results using the investor sentiment (Han, 2008), which is the aggregate error in investor beliefs. It is defined in this context as the ratio of net long non-commercial positions over total open interest in each of the 10 commodity futures market considered in the analysis. Both measures rely on data on investors' positions from the Commodity Futures Trading Commission (CFTC) and are available at weekly frequency, sampled on Tuesday.

Results are reported in Table A.3.a-b. Both hedging pressure and investor sentiment measures are generally jointly significant in the long-run as well as in the short-run. These results reflect the joint significance tests for the Working's T reported in Table 5.b.

[TABLE A.3.a-b ABOUT HERE]

We now turn to the measurement of economic activity. While the *ADS* tracks the real U.S. economy only, emerging economies (China above all) have been recognized as a major driver of commodity demand in the recent years. For this reason, it is relevant to look at a measure of global real economic activity. However, there is a lack of such information at weekly frequency. As a compromise, trading-off data frequency and geographical scope, we adopt the World Industrial Production (*WIP*) as suggested by Baumeister and Hamilton (2017) as robustness check. Results reported in Table A4.a-b are indeed robust.

As a further check at monthly frequency, we investigate the relationship between DCCs and inflation. Commodities have long been advocated as a way to hedge against inflation (Greer, 1978). Büyükşahin and Robe (2014) find that stock-commodity correlations decrease in periods of higher inflation, as commodities may provide a better hedge against inflation than equities do.

We investigate the role of inflation on commodity dynamic conditional correlations at monthly frequency, as data for inflation and expected inflation are not available at a higher frequency. We measure inflation (*INFL*) using the consumer price index for all urban consumers as provided by

Federal Reserve Economic Data (FRED), Federal Reserve Bank of St. Louis, while expected inflation (*EINFL*) is measured as the median expected price change in next 12 months. This series is produced by the University of Michigan and delivered by FRED.

Inflation and expected inflation display a negative and significant coefficient, both in the short and long run.

[TABLE A.4.a-b ABOUT HERE]

Finally, as the analysis considers a time span over an interval of more than 16 years, which include the 2008 financial crisis and the subsequent great recession, we investigate whether results differ before and after 2008.

We run the ARDL(1,1) model over two different time periods and report the results in Table A.5.a-b for the 1998-2007 time interval and Table A.6.a-b for the 2008-2014 interval. The likelihood ratio test reported at the bottom of Table A.6.b shows that coefficients differ across the two periods considered. The coefficient estimates show that the macroeconomic and financial variables generally display larger statistical significance after the crisis, as evident from the comparison between the pre and post 2008 estimates reported in Tables A.5.a and A.6.a. The Working's T indexes appear to be generally more significant after 2008, as shown by the joint significance tests reported in Tables A.5.b and A.6.b. If we focus on the energy-agriculture and energy-metals subsamples of DCCs we observe that the Working's T indexes for the energy futures markets appear to be significantly related to the DCCs.

[TABLE A.5.a-b ABOUT HERE]

[TABLE A.6.a-b ABOUT HERE]

A. References

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Table A.1: Correlation matrix for commodity futures returns

	Copper	Corn	Gold	Oats	Rice	Silver	Soybeans	Wheat	WTI	NG
Copper	1.00									
Corn	0.17***	1.00								
Gold	0.29***	0.15***	1.00							
Oats	0.13***	0.48***	0.13***	1.00						
Rice	0.12***	0.19***	0.09***	0.17***	1.00					
Silver	0.36***	0.21***	0.73***	0.17***	0.13***	1.00				
Soybeans	0.22***	0.57***	0.16***	0.33***	0.25***	0.23***	1.00			
Wheat	0.18***	0.55***	0.19***	0.37***	0.14***	0.21***	0.37***	1.00		
WTI	0.26***	0.15***	0.25***	0.10***	0.03	0.26***	0.14***	0.15***	1.00	
NG	0.05*	0.13***	0.09***	0.08***	0.02	0.10***	0.14***	0.11***	0.22***	1.00

*** and * represent statistical significance at the 1% and 10% levels, respectively.

Table A.2: Descriptive statistics for the explanatory variables

	Mean	St. Dev.	Min	Max	ADF
ADS	-0.174	0.438	-1.624	0.690	-3.168**
TB3	2.249	2.060	0.010	6.230	-3.312*
Spread	3.395	1.487	0.210	6.210	-2.721*
EX	0.000	0.007	-0.039	0.031	-28.961***
VIX	21.713	8.520	9.900	67.640	-4.993***
WT copper	1.176	0.099	1.021	1.779	-3.704***
WT gold	1.150	0.060	1.064	1.372	-5.686***
WT silver	1.165	0.113	1.045	1.648	-5.105***
WT corn	1.187	0.050	1.110	1.374	-3.755***
WT oats	1.121	0.055	1.027	1.374	-6.243***
WT rice	1.175	0.099	1.021	1.779	-3.848***
WT soy	1.175	0.045	1.082	1.308	-4.890***
WT wheat	1.246	0.066	1.128	1.461	-4.439***
WT WTI	1.110	0.034	1.041	1.216	-3.716***
WT NG	1.172	0.118	1.019	1.574	-2.956

Notes: *** and ** denote statistically significant at the 1% and 5% levels, respectively, the ADF denotes the Augmented Dickey Fuller unit root test, we report the t-statistics.

Table A.3.a: ARDL(1,1) – Alternative trading measures – estimates

Panel A: estimates

	(1) Hedging Pressure		(2) Sentiment	
	LR (θ)	SR (δ)	LR (θ)	SR (δ)
ϕ		-0.087***		-0.087***
		(0.003)		(0.003)
ADS	-0.011***	0.002**	-0.010***	0.002**

	(0.003)	(0.001)	(0.003)	(0.001)
TB3	0.012***	-0.001	0.012***	-0.001
	(0.003)	(0.001)	(0.003)	(0.001)
Spread	0.016***	-0.001	0.016***	-0.001
	(0.003)	(0.001)	(0.003)	(0.001)
EX	0.666***	0.025***	0.681***	0.025***
	(0.154)	(0.006)	(0.154)	(0.006)
VIX	0.001***	-0.000***	0.001***	-0.000***

	(0.000)	(0.000)	(0.000)	(0.000)
Spec. measure WTI	-0.105*	0.007**	-0.062	0.005**
	(0.058)	(0.004)	(0.043)	(0.003)
Spec. measure NG	-0.112***	0.002	-0.036	0.002
	(0.038)	(0.002)	(0.036)	(0.002)
Spec. measure corn	0.055**	0.000	0.048**	0.000
	(0.023)	(0.001)	(0.019)	(0.001)
Spec. measure oats	-0.007	-0.001	-0.005	-0.001

	(0.020)	(0.001)	(0.015)	(0.001)
Spec. measure rice	-0.024	0.002*	-0.016	0.002*
	(0.015)	(0.001)	(0.012)	(0.001)
Spec. measure soy	0.115***	0.002	0.099***	0.002*
	(0.018)	(0.001)	(0.015)	(0.001)
Spec. measure wheat	0.020	0.001	0.012	0.001
	(0.022)	(0.001)	(0.020)	(0.001)
Spec. measure copper	-0.069***	0.001**	-0.053***	0.001

	(0.016)	(0.001)	(0.013)	(0.001)
Spec. measure gold	-0.045***	0.001*	-0.049***	0.001**
	(0.015)	(0.001)	(0.014)	(0.001)
Spec. measure silver	-0.044**	-0.000	-0.044***	-0.000
	(0.017)	(0.000)	(0.016)	(0.000)
Constant		0.011***		0.010***
		(0.002)		(0.002)
N of LR restrictions	15		15	

Observations	37,305	37,305
Log likelihood	44145.76	112950.3

Notes: Model (1) presents results with the hedging pressure measure (De Roon et al., 2000); Model (2) with the investor sentiment measure (Han, 2008). Columns LR report the long-run coefficients (θs), which refer to variables in levels, while the SR columns report the short-run coefficients (δs), which refer to variables in first differences. All models include month and year dummies. *,**,*** denote statistical significance at the 1%, 5% and 10% levels, respectively; Standard errors are reported in parentheses.

Table A.3.b: ARDL(1,1) – Alternative trading measures – tests

Panel B: Statistics	(1) Hedging Pressure		(2) Sentiment	
	LR (θ)	SR (δ)	LR (θ)	SR (δ)
Joint significance test for WTs				
Energy (2)	12.11***	6.13**	3.15	5.66*

	(0.002)	(0.047)	(0.207)	(0.059)
Agriculture (5)				
	49.63***	8.19	50.15***	9.16
	(0.000)	(0.146)	(0.000)	(0.103)
Metals (3)				
	33.28***	9.98**	36.05***	10.39**
	(0.000)	(0.019)	(0.000)	(0.016)
Equality of coefficients test for WTs				
Energy (1)				
	0.01	1.23	0.22	1.04
	(0.921)	(0.267)	(0.639)	(0.307)
Agriculture (4)				
	37.64***	7.60	37.98***	8.33*
	(0.000)	(0.107)	(0.000)	(0.080)

Metals (2)				
	1.64	5.86*	0.19	7.17**
	(0.441)	(0.053)	(0.911)	(0.028)
Joint significance test for year dummies (16)	676.23***		702.60***	
	(0.000)		(0.000)	
Joint significance test for month dummies (11)	151.47***		161.87***	
	(0.000)		(0.000)	

Notes: All tests reported are Chi2 distributed. The number of degrees of freedom is reported in paretheses in the first column. Columns LR report tests on the long-run coefficients (θs), which refer to variables in levels, while the SR columns report tests on the short-run coefficients (δs), which refer to variables in first differences. *,**,*** denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table A.4.a: ARDL(1,1) – Monthly robustness – estimates

Panel A: estimates	(1)	(2)	(3)			
	LR (θ)	SR (δ)	LR (θ)	SR (δ)	LR (θ)	SR (δ)
ϕ		-0.232***		-0.236***		-0.232***
		(0.007)		(0.007)		(0.007)
WIP	-1.680***	0.211***	-1.591***	0.200***	-1.724***	0.214***
	(0.245)	(0.021)	(0.240)	(0.020)	(0.245)	(0.021)
TB3	0.006*	0.002	0.006	0.003*	0.007	0.002
	(0.004)	(0.002)	(0.004)	(0.002)	(0.004)	(0.002)
Spread	1.980***	-0.325***	1.870***	-0.325***	1.852***	-0.302***
	(0.405)	(0.033)	(0.398)	(0.035)	(0.407)	(0.034)
EX	0.009***	0.006***	0.007**	0.007***	0.009***	0.007***

	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)
VIX	0.001***	-0.000	0.001**	-0.000	0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
WT WTI	0.091***	0.003*	0.066**	0.002*	0.088***	0.003*
	(0.032)	(0.002)	(0.031)	(0.001)	(0.032)	(0.002)
WT NG	-0.058	-0.003	-0.073	-0.003	-0.065	-0.003
	(0.062)	(0.003)	(0.062)	(0.003)	(0.061)	(0.003)
WT corn	0.042	0.002	0.053	0.001	0.046	0.002
	(0.035)	(0.001)	(0.035)	(0.001)	(0.035)	(0.001)
WT oats	-0.104*	-0.013*	-0.113*	-0.016*	-0.116*	-0.014*
	(0.061)	(0.008)	(0.058)	(0.009)	(0.060)	(0.008)

WT rice	0.020	0.004**	0.035	0.003*	0.019	0.004*
	(0.052)	(0.002)	(0.052)	(0.002)	(0.052)	(0.002)
WT soy	-0.003	-0.005**	-0.013	-0.005**	-0.002	-0.005**
	(0.033)	(0.002)	(0.034)	(0.002)	(0.033)	(0.002)
WT wheat	-0.293***	0.002	-0.283***	0.002	-0.294***	0.002
	(0.060)	(0.004)	(0.061)	(0.004)	(0.060)	(0.004)
WT copper	-0.084	-0.004	-0.081	-0.004	-0.092*	-0.003
	(0.052)	(0.003)	(0.051)	(0.003)	(0.052)	(0.003)
WT gold	0.065	0.001	0.175	0.002	0.028	-0.001
	(0.138)	(0.007)	(0.135)	(0.008)	(0.138)	(0.008)
WT silver	0.224***	-0.004	0.226***	-0.002	0.197***	-0.001

	(0.071)	(0.005)	(0.070)	(0.005)	(0.073)	(0.004)
INFL			-0.005***	-0.001**		
			(0.001)	(0.000)		
EINFL					-0.001	-0.002**
					(0.003)	(0.001)
Constant		0.042***		0.043***		0.048***
		(0.011)		(0.011)		(0.011)
N of LR restrictions	15	16		16		
Observations	8,820	8,820		8,820		
Log likelihood	23138.78	23181.78		23179.85		

Notes: Model (1) presents the results obtained with the WIP index. Model (2) adds inflation and model (3) adds expected inflation. Columns LR report the long-run coefficients (θs), which refer to variables in levels, while the SR columns report the short-run coefficients (δs), which refer to variables in first differences. Results are at monthly frequency. All models include year dummies. *,**,*** denote statistical significance at the 1%, 5% and 10% levels, respectively; Standard errors are reported in parentheses.

Table A.4.b: ARDL(1,1) – Monthly robustness – tests

Panel B: Statistics						
	(1)	(2)			(3)	
	LR (θ)	SR (δ)	LR (θ)	SR (δ)	LR (θ)	SR (δ)
Joint significance test for WTs						
Energy (2)						
	10.37***	0.65	12.31***	0.22	7.36**	0.02
	(0.006)	(0.723)	(0.002)	(0.897)	(0.025)	(0.990)
Agriculture (5)						
	29.94***	13.48**	29.22***	13.25**	31.31***	12.51**
	(0.000)	(0.019)	(0.000)	(0.021)	(0.001)	(0.029)

Metals (3)						
	10.16**	6.41*	8.17**	5.49	10.13**	6.63*
	(0.017)	(0.093)	(0.043)	(0.139)	(0.018)	(0.085)
Equality of coefficients test for WTs						
Energy (1)						
	1.05	0.30	0.11	0.19	1.17	0.00
	(0.306)	(0.583)	(0.740)	(0.663)	(0.279)	(0.998)
Agriculture (4)						
	20.59***	13.35***	19.48***	13.07***	21.35***	12.29**
	(0.000)	(0.001)	(0.001)	(0.010)	(0.000)	(0.015)
Metals (2)						
	4.69*	3.65	4.10	3.19	4.86*	3.78
	(0.096)	(0.161)	(0.129)	(0.203)	(0.088)	(0.151)
Joint significance test for year dummies (16)	477.76***	613.83***		503.81***		

	(0.000)	(0.000)	(0.000)

Notes: All tests reported are Chi^2 distributed. The number of degrees of freedom is reported in paretheses in the first column. Columns LR report tests on the long-run coefficients (θs), which refer to variables in levels, while the SR columns report tests on the short-run coefficients (δs), which refer to variables in first differences. *,**,*** denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table A.5.a: ARDL(1,1) – 1998-2007 – estimates

Panel A: estimates

1998-2007	all commodities	energy-agriculture	energy-metals			
	LR (θ)	SR (δ)	LR (θ)	SR (δ)	LR (θ)	SR (δ)
ϕ		-0.095***		-0.093***		-0.125***
		(0.004)		(0.007)		(0.011)
ADS	-0.006	-0.001	-0.016**	-0.000	-0.017**	-0.000
	(0.004)	(0.001)	(0.008)	(0.002)	(0.008)	(0.004)
TB3	0.007*	0.000	0.015*	0.001	0.000	0.008***
	(0.004)	(0.001)	(0.008)	(0.002)	(0.007)	(0.003)
Spread	0.006*	-0.001	0.023***	0.000	-0.008	0.004*

	(0.003)	(0.001)	(0.007)	(0.002)	(0.007)	(0.002)
EX	-0.196	0.053***	0.156	0.057***	-1.009**	0.082***
	(0.203)	(0.008)	(0.446)	(0.012)	(0.429)	(0.024)
VIX	0.001***	-0.000***	0.001	-0.000	0.002***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
WT WTI	0.006	-0.003	0.028	-0.003	-0.075	0.014
	(0.122)	(0.004)	(0.170)	(0.005)	(0.193)	(0.011)
WT NG	0.205*	-0.004	0.436**	-0.016	0.067	-0.005
	(0.120)	(0.002)	(0.182)	(0.010)	(0.150)	(0.006)
WT corn	-0.082	-0.009**	0.014	-0.010		
	(0.065)	(0.004)	(0.143)	(0.008)		
WT oats	0.032	0.002*	0.217**	-0.001		
	(0.040)	(0.001)	(0.100)	(0.001)		

WT rice	0.066***	-0.002**	0.041	-0.002		
	(0.023)	(0.001)	(0.037)	(0.001)		
WT soy	-0.173***	-0.000	-0.026	-0.007		
	(0.060)	(0.001)	(0.152)	(0.005)		
WT wheat	-0.110***	-0.002	-0.077	-0.009		
	(0.039)	(0.002)	(0.092)	(0.006)		
WT copper	-0.014	0.002			-0.009	-0.000
	(0.023)	(0.001)			(0.050)	(0.004)
WT gold	-0.043	-0.001			-0.023	-0.003
	(0.047)	(0.001)			(0.080)	(0.005)
WT silver	0.052**	0.002			0.022	0.003
	(0.023)	(0.001)			(0.036)	(0.003)
Constant		0.016***		-0.028***		0.016*

		(0.004)	(0.008)	(0.009)
N of LR restrictions	15	12	10	
Observations	22,770	5,060	3,036	
Log likelihood	69388.83	15448.43	9328.379	

Notes: Columns LR report the long-run coefficients (θs), which refer to variables in levels, while the SR columns report the short-run coefficients (δs), which refer to variables in first differences. All models include month and year dummies. *,**,*** denote statistical significance at the 1%, 5% and 10% levels, respectively; Standard errors are reported in parentheses.

Table A.5.b: ARDL(1,1) – 1998-2007 – tests

Panel B: Statistics						
1998-2007	all commodities	energy-agriculture	energy-metals			
	LR (θ)	SR (δ)	LR (θ)	SR (δ)	LR (θ)	SR (δ)
Joint significance test for WTs						
Energy (2)	2.94	2.86	5.72*	3.28	0.35	3.06
	(0.230)	(0.240)	(0.057)	(0.194)	(0.838)	(0.216)
Agriculture (5)	27.05***	25.24***	6.64	54.52***		
			(0.249)			
	(0.000)	(0.000)		(0.000)		
Metals (3)	6.29*	5.46			0.47	2.56
	(0.098)	(0.141)			(0.925)	(0.464)
Equality of coefficients test for WTs						
Energy (1)	1.34	0.06	2.7	1.12	0.34	2.95*

	(0.247)	(0.799)	(0.101)	(0.289)	(0.560)	(0.086)
Agriculture (4)	27.04***	18.27***	4.93	4.89		
			(0.294)	(0.299)		
	(0.000)	(0.001)				
Metals (2)	5.64*	3.93			0.40	1.84
	(0.060)	(0.140)			(0.818)	(0.398)
Joint significance test for year dummies (9)	56.10***	457.73***		130.96***		
	(0.000)	(0.000)		(0.000)		
Joint significance test for month dummies (11)	178.73***	303.89***		2.44		
	(0.000)	(0.000)		(0.786)		

Notes: All tests reported are Chi^2 distributed. The number of degrees of freedom is reported in paretheses in the first column. Columns LR report tests on the long-run coefficients (θs), which refer to variables in levels, while the SR columns report tests on the short-run coefficients (δs), which refer to variables in first differences. *,**,*** denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table A.6.a: ARDL(1,1) – 2008-2014 – estimates

Panel A: estimates

2008-2014	all commodities	energy-agriculture	energy-metals			
	LR (θ)	SR (δ)	LR (θ)	SR (δ)	LR (θ)	SR (δ)
ϕ		-0.098***		-0.107***		-0.094***
		(0.005)		(0.006)		(0.016)
ADS	-0.020***	0.009***	-0.004	0.006**	-0.039***	0.010***
	(0.004)	(0.001)	(0.007)	(0.003)	(0.011)	(0.003)
TB3	0.038***	-0.007***	0.001	0.002	0.019	-0.002
	(0.007)	(0.001)	(0.014)	(0.002)	(0.019)	(0.002)
Spread	0.038***	-0.002**	0.031***	0.003***	0.056***	0.002

	(0.004)	(0.001)	(0.007)	(0.001)	(0.010)	(0.002)
EX	0.990***	0.028**	0.236	0.039**	0.930*	0.069*
	(0.188)	(0.011)	(0.355)	(0.018)	(0.515)	(0.038)
VIX	0.001***	-0.000***	0.002***	-0.000**	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
WT WTI	0.843***	-0.011**	0.864***	-0.022*	0.297	-0.029*
	(0.187)	(0.004)	(0.196)	(0.012)	(0.267)	(0.016)
WT NG	0.114**	0.009***	0.201***	0.027**	-0.048	0.026*
	(0.058)	(0.003)	(0.074)	(0.010)	(0.123)	(0.014)
WT corn	-0.234***	0.003	-0.157	0.006		
	(0.068)	(0.004)	(0.119)	(0.009)		
WT oats	0.126***	-0.005*	0.084	-0.006		
	(0.042)	(0.003)	(0.107)	(0.005)		

WT rice	0.050	-0.005***	-0.022	-0.005		
	(0.046)	(0.002)	(0.079)	(0.005)		
WT soy	-0.070	0.005	0.004	0.007		
	(0.056)	(0.005)	(0.101)	(0.005)		
WT wheat	-0.392***	-0.006	-0.156	-0.003		
	(0.107)	(0.005)	(0.182)	(0.006)		
WT copper	0.250***	0.002			0.128	-0.002
	(0.059)	(0.001)			(0.133)	(0.001)
WT gold	-0.214***	-0.008**			-0.218	-0.010
	(0.061)	(0.004)			(0.177)	(0.014)
WT silver	0.016	-0.003			0.163	-0.006
	(0.067)	(0.003)			(0.112)	(0.005)
Constant		-0.004		-0.064***		-0.027**

		(0.008)	(0.015)	(0.011)
N of LR restrictions	15	12	10	
Observations	14,535	3,230	1,938	
Log likelihood	44070.97	10043.4	5904.063	

Notes: Columns LR report the long-run coefficients (θs), which refer to variables in levels, while the SR columns report the short-run coefficients (δs), which refer to variables in first differences. All models include month and year dummies. *,**,*** denote statistical significance at the 1%, 5% and 10% levels, respectively; Standard errors are reported in parentheses.

Table A.6.b: ARDL(1,1) – 2008-2014 – tests

Panel B: Statistics						
2008-2014	all commodities	energy-agriculture	energy-metals			
	LR (θ)	SR (δ)	LR (θ)	SR (δ)	LR (θ)	SR (δ)
Joint significance test for WTs						
Energy (2)						
	24.57***	15.85***	28.37***	20.91***	1.34	18.96***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.513)	(0.000)
Agriculture (5)						
	34.59***	19.38***	3.10	7.83		
	(0.000)	(0.002)	(0.685)	(0.166)		
Metals (3)						
	30.24***	9.05**			4.76	5.88
	(0.000)	(0.029)			(0.190)	(0.118)
Equality of coefficients test for WTs						

Energy (1)							
	13.70***		15.18***	9.74***	20.15***	1.31	18.69***
	(0.000)		(0.000)	(0.002)	(0.000)	(0.252)	(0.000)
Agriculture (4)							
	34.52***		9.23*	2.80	7.55		
	(0.000)		(0.056)	(0.593)	(0.109)		
Metals (2)							
	29.92***		9.04**			3.67	1.03
	(0.000)		(0.011)			(0.160)	(0.598)
Joint significance test for year dummies (6)		98.38***	154.45***		277.48***		
		(0.000)	(0.000)		(0.000)		
Joint significance test for month dummies (11)		395.85***	208.26***		7.81		
		(0.000)	(0.000)		(0.167)		
Equality of coefficients test for the 1998-2007 and 2008-2014 periods		1497.07***	290.32***		260.23***		
		(0.000)	(0.000)		(0.000)		

Notes: All tests reported are Chi^2 distributed. The number of degrees of freedom is reported in paretheses in the first column. Columns LR report tests on the long-run coefficients (θs), which refer to variables in levels, while the SR columns report tests on the short-run coefficients (δs), which refer to variables in first differences. *,**,*** denote statistical significance at the 1%, 5% and 10% levels, respectively.